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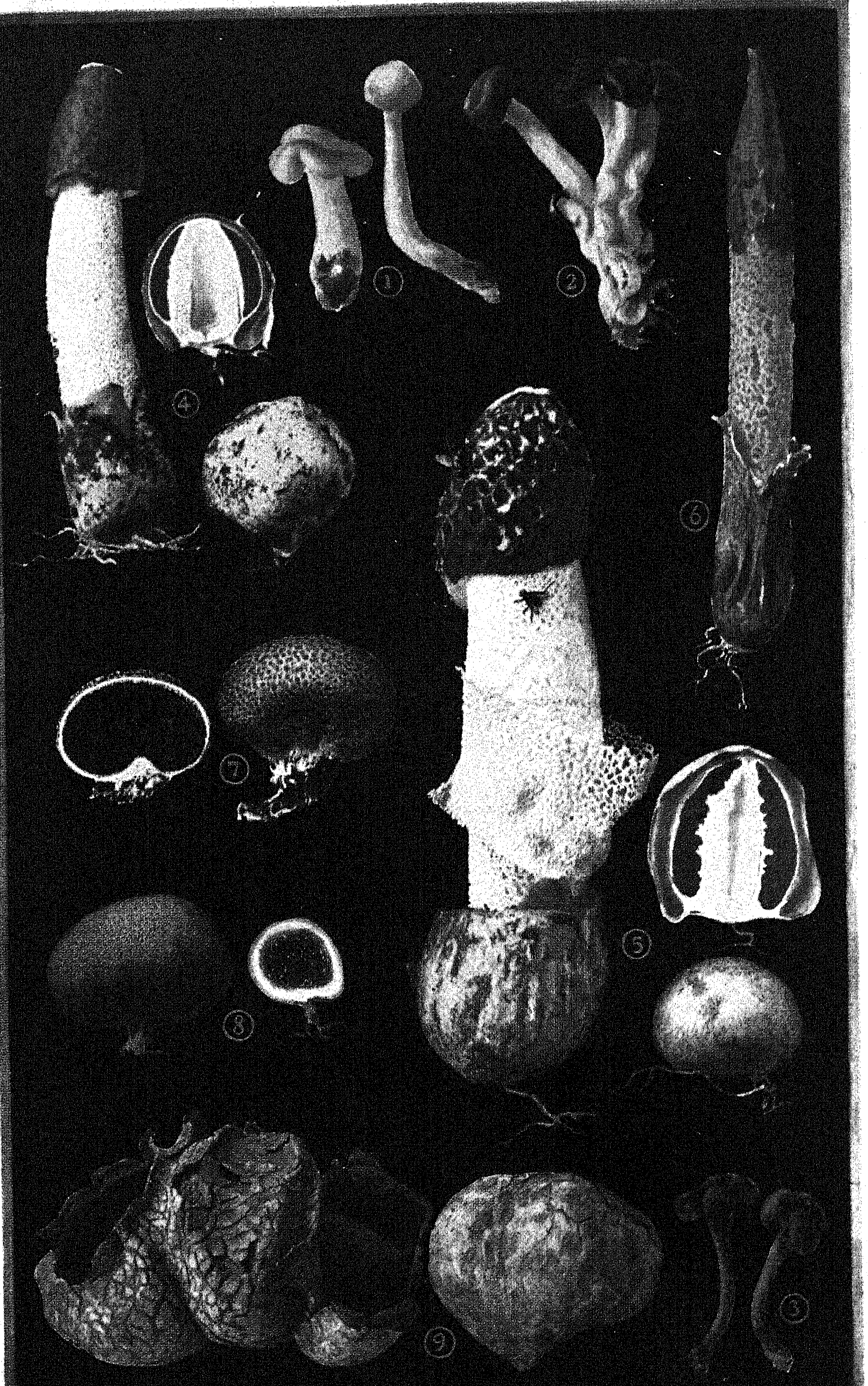

ILLUSTRATIONS OF FUNGI

MYCOLOGIA

Vol. II JANUARY, 1910 No. 1

ILLUSTRATIONS OF FUNGI—V

William A. Murrill

Most of the species here figured belong to the Gasteromycetes. The illustrations were made from specimens collected in or near Bronx Park, New York City. The three species of *Leotia*, belonging to the Discomycetes, were found at Chappaqua, New York. The descriptions of these three species are mainly drawn from Durand's excellent monograph of the Geoglossaceae of North America.

Leotia lubrica (Scop.) Pers.

Yellow Leotia

Plate 17. Figure 1. $\times$ 1

Plants usually densely clustered, more or less viscid-gelatinous, ochraceous-yellow, often with a greenish or olive tint, especially with age or on partial drying, 3–6 cm. or more high; ascigerous portion pileate, convex above, the surface often irregularly furrowed, with a recurved margin, wrinkled or nodulose, 1–1.5 cm. broad: stem terete or somewhat compressed, usually slightly tapering upward, the adjacent ones often coalescing below, about 1 cm. thick below, 0.5 cm. thick above, minutely squamulose, sometimes with innate greenish granules; asci narrowly clavate, $130–160 \times 10–12\,\mu$; spores 8, hyaline, smooth, subfusiform, $18–28 \times 5–6\,\mu$, becoming 5–7-septate; paraphyses filiform, branched, hyaline.

This species, said to be edible, is the commonest member of the Geoglossaceae in the eastern United States, occurring on rich humus or sandy soil in woods from Ontario to Alabama and west to Iowa. It is very variable in color and consistency, being

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sensitive to differences in situation, moisture, and substratum. Several of its forms have received specific names.

Leotia stipitata (Bosc) Schroet.

TWO-COLORED LEOTIA

Plate 17. Figure 2. × 1

Plants solitary or clustered, viscid-gelatinous, 3–6 cm. or more high; ascigerous portion 1–2 cm. or more broad, margin incurved toward the stem, even or irregularly nodulose, hymenium deep aëruginous-green, whitish below: stem terete or slightly tapering upward, white or pale-ochroleucous, 2–4 cm. high, 0.5–1 cm. thick, often beset with minute green squamules: asci narrowly clavate-cylindrical, $118–150 \times 10 \mu$; spores 8, hyaline, smooth, becoming 5 or more septate, $16–28 \times 5–6 \mu$; paraphyses filiform, branched, the apices intensely green when fresh.

This species occurs in rich humus or soil in woods from Maine to Florida and west to California. Its colors are constant under all conditions, and it does not intergrade with other species. The dark bluish-green cap and pale-yellow or white stem form a very striking contrast and easily distinguish it from the two other species.

Leotia chlorocephala Schw.

GREEN LEOTIA

Plate 17. Figure 3. × 1

Plants solitary to densely clustered, subgelatinous, entirely green, 1–5 cm. high; ascigerous portion hemispherical, convex, margin incurved, obtuse, hymenium smooth or furrowed, the margin often lobed or nodulose, pea-green to aëruginous, 2–10 mm. wide; stem terete, firm, the middle layer green, surface densely squamose or furfuraceous with green granules, 1–4.5 cm. high, 2–4 mm. thick, changing little in color on drying: asci narrowly clavate, $125–150 \times 10–12 \mu$; spores 8, hyaline or faintly greenish, narrowly ellipsoid, becoming about 5-septate, $18–20 \times 5–6 \mu$; paraphyses filiform, branched, the apices green.

This plant is entirely green and opaque, with furfuraceous stem. The name assigned it by Schweinitz has caused some confusion because it applies better to *L. stipitata,* which is "green-headed." It occurs on sandy soil in rich woods or among mosses in ravines from New Hampshire to Alabama.

Dictyophora Ravenelii (Berk. & Curt.) Burt

SAWDUST STINKHORN

Plate 17. Figure 4. $\times \frac{1}{2}$

Pileus conic-campanulate, 2.5–3.5 cm. long, the surface white and granulate or minutely wrinkled after the disappearance of the olivaceous gleba; apex smooth, white, umbilicate, closed by a thin membrane or at length perforate; spores oblong-ellipsoid, $4\text{–}5 \times 2\,\mu$, involved in mucus; stipe cylindric, slender, tapering at each end, cellular-spongy, white, hollow, 10–12 cm. high, 2 cm. thick; veil membranous, usually scarcely half the length of the pileus and concealed beneath it, very rarely protruding; volva ovoid, pinkish, 4–5 cm. in diameter, containing the lower half of the veil attached about the base of the stipe.

This species occurs in abundance in old sawdust piles and about rotting logs and stumps in woods and fields in the eastern United States and Canada. It may be readily distinguished from the veiled stinkhorn by the absence of a conspicuous, reticulate veil; its cap is also smooth instead of coarsely pitted, and its odor is less penetrating and disagreeable.

Dictyophora duplicata (Bosc) Ed. Fisch.

VEILED STINKHORN

Plate 17. Figure 5. $\times \frac{2}{3}$

Pileus campanulate, 5 cm. long, the surface appearing strongly reticulate-pitted after the fetid, olivaceous gleba has been devoured by flies or washed away by rains; apex truncate, perforate; spores oblong-ellipsoid, $4 \times 2\,\mu$, involved in mucus at maturity; stipe fusiform-cylindric, tapering at each end, cellular-spongy, white, hollow, 10–20 cm. high, 2.5–3 cm. thick; veil white, reticulate, variable in length, sometimes much expanded, always conspicuous, fragile; volva globose, nearly white, very poisonous, 5–7 cm. in diameter.

This very conspicuous and objectionable species occurs in the United States about buildings and near stumps in fields and in the edges of woods. It may be easily recognized by its conspicuous veil, which is attached near the apex beneath the pileus and hangs down to the middle of the stipe or lower. The mature gleba is extremely fetid, proving attractive to flies, which probably disseminate the spores. *Ithyphallus impudicus* (L.) Ed.

Fisch., another very fetid stinkhorn, abundant in Europe and reported rarely in this country, has no veil of any kind, although its pileus is reticulated similarly to that of the veiled stinkhorn. Both of these species may be exterminated in lawns and groves by the use of quick-lime, as described in MYCOLOGIA for March, 1909.

Mutinus elegans (Mont.) Ed. Fisch.

HEADLESS STINKHORN

Plate 17. Figure 6. $\times \frac{1}{2}$

Stipe horn-shaped, cylindric, tapering gradually to the apex, pitted, hollow, white or pinkish below, bright-red or orange above, 10–17 cm. long, about 2 cm. thick; apex conic-acuminate, perforate; gleba greenish-brown, semifluid, fetid, smeared over the upper portion of the stipe in an indefinite manner; spores oblong-ellipsoid, $4–5 \times 2\,\mu$; veil none; volva oblong-ovoid, pinkish, 2.5–3 cm. long.

This species is very conspicuous by reason of its size and brilliant coloring. It occurs rather commonly in the United States in rich cultivated grounds or woods. A smaller species, *Mutinus caninus* (Huds.) Fries, found rarely in the eastern United States and also in Europe, may be readily distinguished by its more distinct pileus and very faint odor. Both species readily lose the greenish slime containing the spores, since this is eagerly devoured by flies and easily washed away by light rains.

Scleroderma aurantium (L.) Pers.

COMMON SCLERODERMA. HARD-SKINNED PUFFBALL

Plate 17. Figure 7. $\times \frac{1}{2}$

Peridium depressed-globose, subsessile, radicate, often cespitose, 2.5–8 cm. in diameter, thick, corky, usually pale with yellow shades, or orange, sometimes brown, mostly covered with large warts; gleba at first white, then vinaceous to bluish-black, finally greenish-gray, lines of trama whitish; spores dark, globose, warted, $7–12\,\mu$.

A very common and widely distributed species growing in dry woods, especially under chestnut trees. I have eaten the young sporophores, but do not consider them attractive. Persons have

brought them to me thinking they were truffles. In section, and in the method of disseminating its spores, this species closely resembles the preceding one.

Scleroderma verrucosum (Bull.) Pers.

SMALL-WARTED SCLERODERMA

Plate 17. Figure 8. $\times \frac{2}{3}$

Peridium subglobose, 2.5–7 cm. in diameter, ochraceous, purplish or dingy-brown, thin and fragile above, covered with minute warts, continued below into a more or less elongated stem-like base, sometimes reaching 3 cm. or more in length, when it is usually lacunose; gleba white, then vinaceous to black, at length umbrinous, lines of trama whitish; spores globose, warted, dark, 8–13 μ.

This species is neither so common nor so well known as the following species, from which it differs in having much smaller warts. It is also usually of smaller size in this region and often more purplish or brownish in color. It occurs on sandy ground and roadsides in woods, and is of wide distribution. A section of the young sporophore shows a broad white border, with a firm, wine-colored to black interior marked with whitish lines. This mass later becomes umbrinous and powdery and escapes through the rupture of the upper portion of the peridium.

Scleroderma Geaster Fries

STELLATE SCLERODERMA

Plate 17. Figure 9. $\times \frac{1}{2}$

Peridium large, globose, sessile, often cespitose, thick, nearly smooth, yellowish-brown or greenish-brown, splitting at maturity in a stellate manner at the apex, reminding one of an earth-star; gleba umbrinous with a purple tinge, trama whitish; spores globose, coarsely warted, 12–16 μ in diameter.

This large, dull-colored species is quite abundant in the eastern United States on banks and roadsides and in short grass in thin woods. It is usually half imbedded in the earth and this fact together with its dull colors render it inconspicuous until maturity. It often much resembles a potato that has been exposed

to the light and has become somewhat greenish. The splitting of the upper portion into lobes is quite characteristic. An earth-star splits in this way more completely and regularly and has in addition an inner peridium containing the spore-mass.

A CORRECTION IN NOMENCLATURE

Howard J. Banker

In the second edition of the *Species Plantarum* in 1763, Linnaeus described a fungus which he called *Hydnum parasiticum* as follows: "acaule arcuato-rugosum tomentosum. Habitat in Europae arboribus." This appears to be the original publication of the species and Linnaeus never furnished any more complete account of the plant. It seems practically impossible from so meager a characterization to identify the plant thus named. In later editions of the *Species Plantarum* the name and description are continued unchanged. In 1769, a plant was figured in *Flora Danica pl. 465,* which was supposed to be the Linnaean species. The figure, however, fails to give any more definite characters of the plant. In the same year Weigel quotes the Linnaean species and appends a more elaborate description.* The fact that he states that the plant described by him is at first gelatinous raises the question whether he really had the Linnaean plant. In 1787, Willdenow described a plant† which he doubtfully referred to *Hydnum parasiticum* L. and the next year he repudiated his determination by figuring and describing his plant as a new species with the name *Agaricus decipiens.*‡ It seems evident, therefore, that even the earlier botanists were more or less in doubt as to the identity of the Linnaean plant.

About 1800, Olof Swartz sent to Persoon a specimen from Sweden which he affirmed to be the true *Hydnum parasiticum* L. This plant Persoon figured and fully described under the Linnaean name in his *Icones et Descriptiones Fungorum* **2**: 55. *pl. 14, f. 2.* 1800. The figure is so well executed that it leaves no doubt as to the plant represented. Soon after this was published Swartz wrote Persoon, according to the latter, that the plant was not the *Hydnum parasiticum* of Linnaeus. Persoon now did a

* Flora Pomerano-Rugica, *222.* 1769.

† Florae Berolinensis Prodromus, 396. 1787.

‡ Observationes Botanicae in Mag. für die Bot. 12. *pl. 2, f. a, b, c.* 1788.

peculiar thing. He published the Swartzian plant in his *Synopsis Methodica Fungorum,* in 1801, as *Hydnum parasiticum,* but stated that it was not *Hydnum parasiticum* L. Persoon appears to have disposed of the Linnaean plant by transferring it to the genus *Sistotrema,* for he says, "quod vide sub *Sistotremate,*" but in his treatment of the genus *Sistotrema* there is no citation of the Linnaean species and none of the descriptions seem to apply to that form. From this date the Linnaean plant appears to have been disregarded by botanists.

In 1810, Swartz himself described the plant which he had sent to Persoon and named it *Hydnum strigosum.** Neither Swartz nor the later European botanists have laid any special emphasis on the branched processes which are a peculiar characteristic of the body of this Swartzian plant, although this feature is figured and mentioned by Persoon; nor have we noted any mention of the hot, peppery taste of the fresh plant, which is a striking and characteristic feature.

About 1840 or a little later, T. G. Lea collected in Ohio a resupinate plant which in other respects possessed all the characteristic features of *H. strigosum* Sw. This was sent to Rev. M. J. Berkeley, of England, who described it in 1845 as *Hydnum stratosum.*† Berkeley commented extensively on the unique feature of the branched processes, remarking that it was one of the most remarkable species with which he was acquainted. He likens the plant to "*Hydnum parasiticum,*" but says it "has not like that a coriaceous pileus." His citation of name without author has in this case little significance. If he referred to *H. parasiticum* Pers., it was the same as *H. strigosum* Sw., but in that case his comment is misleading, since the structure and substance of the pilei of *H. strigosum* Sw. and *H. stratosum* Berk. are essentially alike and both are characterized by the branched processes.

H. stratosum Berk. appears never to have been reported from Europe and seems to be rare in this country. A. P. Morgan, who lived and collected in the same region of Ohio where Lea did, commented many years later on the fact that *H. stratosum* Berk.

* Kongl. Vetensk. Acad. nya Handl. 1810: 250. 1810.

† Lond. Jour. Bot. 4: 307. 1845.

had never been found again and expressed serious doubt as to its existence.* However, the plant does exist and is a good species. In 1887, Underwood and Cook found specimens in central New York which were correctly determined by C. H. Peck as *H. stratosum* Berk., and again Underwood found a specimen of the same species in Indiana in 1891. So far as the writer can determine, these three collections are the only ones made of this species in the world.

In 1904, the writer, searching through the vast accumulation of the Ellis collection at the New York Botanical Garden, discovered a specimen which he recognized as having the fundamental characters of *H. stratosum* Berk., but it was distinctly pileate. This specimen was collected by Ellis as early as 1855, and had been submitted to Ravenel, who replied "new and very curious." The plants, however, had never been described, probably because the material was scanty. Later specimens having the branched character greatly obscured by a more compact pileus were referred by Ellis to *H. strigosum* Sw. It was the writer's fortune the next summer after seeing these specimens to find a fine growth of the plant on an old stump in a deep, moist hollow at Schaghticoke, N. Y., where an abundance of fresh material was obtained.† The possibility of the plant's being *H. strigosum* Sw. was considered, but authentic material of Swartz's plant could not be obtained, and at that time a copy of Persoon's paper, *Icones et Descriptiones Fungorum,* was not accessible. The failure of the European botanists to emphasize the most unique feature of the plant and especially Berkeley's comment on that feature led the author to believe that the plant represented a distinct species. Moreover, the unusual character seemed to warrant the segregation of this and Berkeley's species as a separate genus. The plant was, therefore, described and named *Leaia piperata.*‡

Recently, among some material received from Dr. Lars Romell, of Sweden, were found a few specimens of what is there con-

* Jour. Cin. Soc. Nat. Hist. 10: 9. 1887.

† This old stump has continued to furnish a crop of the sporophores every year since, this being the sixth consecutive season that they have been observed.

‡ Mem. Torrey Club 12: 175. 1906.

sidered *Hydnum strigosum* Sw. These were at once recognized as being the same as *Leaia piperata*. A copy of Persoon's *Icones et Descriptiones Fungorum* was examined during the past summer and it was evident that the two species were identical. In the publication of the writer's Contribution to a revision of the North American Hydnaceae,* it seemed necessary to include *Hydnum strigosum* Sw., although the species was not well understood, since there had been found in the Schweinitz herbarium a peculiar plant that had been referred to the above species, and correctly, so far as could be determined. On the evidence of the Schweinitz specimen and the supposedly correct interpretation of Swartz's description, the species was placed in the genus *Steccherinum* and inadequately described, as was intimated at the time. It now seems doubtful if the Schweinitz specimen is the true *Hydnum strigosum* Sw., but a reëxamination of the plant would be necessary to positively settle the question. Be that as it may, it is now evident that the Swartzian species was wrongly disposed of.

With the settling of the question as to what constituted the true *H. strigosum* Sw., a new problem arose. The writer had made his species *Leaia piperata* the type of a new genus. With the determination of the identity of his plant with the Swartzian species, it is evident that the latter becomes the type of the genus. However, in 1879, P. A. Karsten had established the genus *Gloiodon* on *Hydnum strigosum* Sw. and two other species.† Ten years later he established the monotypic genus *Sclerodon* on *H. strigosum* Sw., quoting his own genus *Gloiodon* as a synonym.‡ In accordance with the principles here followed,§ the genus must be known as *Gloiodon*.

The correct nomenclature of the two species here discussed, with their synonomy, would, therefore, be as follows:

GLOIODON STRIGOSUS (Sw.) P. Karst., Medd. Soc. Faun. et Fl. Fenn. **5**: 28. 1879.

* Mem. Torrey Club **12**: 99–194. 1906.

† Medd. Soc. Faun. et Fl. Fenn. **5**: 28. 1879.

‡ Finlands Basids. 360. 1889.

§ See Banker, A historical review of the proposed genera of the Hydnaceae, Bull. Torrey Club **29**: 436–448. 1902.

Hydnum parasiticum Persoon, Icon. et Descrip. Fung. **2**: 55. *pl. 14, f. 2.* 1800. Not *H. parasiticum* L. Sp. Pl. ed. 2, **2**: 1648. 1763.

Hydnum strigosum Swartz, Kongl. Vetensk. Acad. nya Handl. **1810**: 250. 1810.

Sclerodon strigosus (Sw.) P. Karst., Finl. Basidsv. 361. 1889.

Steccherinum strigosus (Sw.) Banker, Mem. Torrey Club **12**: 128. 1906.

Leaia piperata Banker, Mem. Torrey Club **12**: 175. 1906.

Gloiodon stratosus (Berk.) comb. nov.

Hydnum stratosum Berkeley, Lond. Jour. Bot. **4**: 307. 1845.

Leaia stratosa (Berk.) Banker, Mem. Torrey Club **12**: 177. 1906.

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THREE COMMON SPECIES OF AURICULARIA

MARY F. BARRETT

1. **Auricularia Auricula** (L.) Underwood, Mem. Torrey Club 12: 15. 1902

Tremella Auricula L. Sp. Pl. 1157. 1753.
Peziza Auricula L. Syst. Nat. ed. 12, 2: 725. 1767.
Merulius auricula Roth. Germ. 1: 535. 1788.
Peziza Auricula-Judae Bull. Champ. 1: 241. 1791.
Tremella Auricula Judae Pers. Obs. Myc. 2: 93. 1799.
Auricularia sambucina Mart. Fl. Crypt. Erl. 459. 1817.
Exidia Auricula Judae Fr. Syst. 2: 221. 1822.
Auricularia ampla Pers. in Freyc. Voy. 177. 1826.
Exidia auricula Wallr. Fl. Crypt. 2: 559. 1833.
Exidia ampla Lév. Ann. Sci. Nat. Bot. III. 5: 159. 1846.
Hirneola auricula-Judae Berk. Outl. 289. 1860.
Hirneola ampla Sacc. Syll. 6: 765. 1888.
Auricularia Auricula Judae Schröt. Krypt. Fl. Schles. 3: 386. 1889.
Auricula Judae Kuntze, Rev. Gen. 2: 844. 1891.
Auricula ampla Kuntze, Rev. Gen. 2: 844. 1891.

Erumpent, single or cespitose; at first peziza-form, then becoming erect and foliaceous, much twisted, slightly ear- or shell-shaped, one or several lobed, sessile or substipitate, up to 12 cm. in height; thin gelatinous, trembling when moist; sterile surface curling over hymenium, red-brown when moist, yellowish-brown to olive-brown when dry, when young glaucous, when older ashy, pruinose with fine short hairs, irregularly veined, sometimes appearing quilted; hymenium when moist red-brown like coffee jelly, smooth, undulating but not folded or wrinkled; hymenium when dry or old becoming almost black, shining, or dull with a white bloom, sometimes folded according to manner of drying; spores typical of the genus, $11–14 \times 5–6\,\mu$.

HABITAT: Dead wood of various kinds.

DISTRIBUTION IN NORTH AMERICA: Wide. Specimens were examined from various parts of Canada, Maine, New Hampshire,

Connecticut, New York, New Jersey, Pennsylvania, Maryland, District of Columbia, Virginia, West Virginia, South Carolina, Georgia, Alabama, Louisiana, Arkansas, Missouri, Tennessee, Ohio, Indiana, Iowa, Minnesota, Kansas, Colorado, Montâna, the West Indies, and the Philippines. It is reported also from Massachusetts, North Carolina, Texas, Nebraska, and California.

EXSICCATI: There are specimens in most of the usual European and American exsiccati.

ILLUSTRATIONS: Hussey, Ill. Brit. Myc. *pl. 53;* Eng. Bot. ed. **1**: *2447;* Berk. Outl. *pl. 18, f. 7;* Cooke, Handbook, *f. 97;* Bolt. Hist. Fungi, **2**: *pl. 107;* Batt. Fung. Agri. *pl. 3, f. F;* Sterb. Theat. *pl. 27, f. H;* Mich. Nov. Gen. *pl. 66, f. 1;* Blackw. Herball, *pl. 334;* Marshall, Mushroom Book, *116;* Brefeld, Unters. **7**: *pl. 4, f. 3, 4.*

This fungus is the well-known Jew's ear or Judas' ear, which was described under that name at least as far back as the end of the sixteenth century. Since that time it has had perhaps three times as many names as the above list of synonyms would seem to indicate. Undoubtedly many even of the comparatively recently described species of *Auricularia* will eventually be referred back to this species.

Such multiplication of names is of course due to the wide distribution of the Judas' ear, to its ability to grow upon many different kinds of decaying wood, and to its great variation in size, color and shape. Young specimens are usually not only smaller, but lighter in color and smoother. Gradations in this respect were admirably shown by one set of specimens from Jamaica (No. *1123*, Mrs. N. L. Britton Coll., Oct. 4, 1908). Then too, in a fungus of which about 80 per cent. is water (Weems & Hess in Proc. Soc. Prom. Agr. Sci **23**: 167. 1902) the method of drying will affect its appearance, and may lead to confusion unless specimens to be determined are soaked with water until they regain their original condition.

The chief interest of the Jew's ear for the botanists of the seventeenth and eighteenth centuries seems to have lain in the question of its edibility. Gerarde (Herball, 1385. 1597) says: "the Mushrums or Toadstooles which grow upon the trunks or bodies of old trees, verie much resembling Auricula Iudae, that

is Iewes' eare . . . are all thought to be poisonsome being inwardly taken." L'Ecluse (Hist. Rar. Pl. 4: 276. 1601) although naming it "genus 1. perniciosum fungorum" says that it may be used in cases of sore throat for gargling and rinsing. Parkinson (Theat. 1320. 1640) states positively that it must be edible, because it may be "boyled in milke, or steeped in vinegar and so gargled, which is the onely use they are put unto that I know." The final word on the subject has been given recently by Weems and Hess in the article quoted above. They state its composition when moist to be: water 79.58 per cent., ether extract .25 per cent., crude fiber .59 per cent., protein 3.83 per cent., ash 1.04 per cent., nitrogen free extract 14.71 per cent. Its fuel value per lb. in calories is 355.10.

It is altogether probable that *Auricularia auriformis* (Schw.) Earle is the same fungus. The only difference seems to be in the yellow color on both surfaces of *A. auriformis,* due in the case of the hymenium to nodules of gelatine, and on the sterile surface to the hairs. Specimens from various localities in New Jersey and Alabama were examined, and the fungus is reported also from Massachusetts, Virginia, North Carolina (type), Ohio, and Porto Rico. The Wright specimen from Cuba is, as stated by Farlow (Bib. Index 1: 306. 1905), not *A. auriformis* but *A. Auricula.*

If these two fungi prove to be the same the following synonyms should be added to those of *A. Auricula:*

Peziza auriformis Schw. Syn. Carol. no. *1155.* 1818.

Exidia auriformis Fr. Syst. 2: 223. 1822.

Tremella auriformis Spreng. in L. Syst. Veg. ed. 16. 4: 535. 1827.

Exidia protracta Lév. Ann. Sci. Nat. III, 2: 218. 1844.

Hirneola auriformis Fr. Fung. Nat. 26. 1848.

Hirneola protracta Sacc. Syll. 6: 766. 1888.

Auricula auriformis Kuntze, Rev. Gen. 2: 844. 1891.

Auricula protracta Kuntze, Rev. Gen. 2: 844. 1891.

Auricularia auriformis Earle in Mohr, Contrib. U. S. Nat. Herb. 6: 194. 1901.

2. **Auricularia nigrescens** (Sw.) Farl. Bib. Index, **1**: 308. 1905

Peziza nigrescens Sw. Prod. 150. 1788.
Peziza nigricans Sw. Fl. Ind. Occ. **3**: 1938. 1806.
Exidia purpurascens Jungh. Praem. 25. 1838.
Exidia hispidula Berk. Ann. Nat. Hist. **I. 3**: 396. 1839.
Exidia polytricha Mont. Pl. Cell. Cuba, 365. 1841.
Hirneola nigra Fr. Fung. Nat. 27. 1848.
Hirneola polytricha Fr. Nov. Act. Roy. Soc. Sci. Upsal. III., **1**: 117. 1855.
Hirneola hispidula Berk. Jour. Linn. Soc. **14**: 352. 1874.
Auricularia polytricha Sacc. Misc. **2**: 12. 1885.
Auricula hispidula Kuntze, Rev. Gen. **2**: 844. 1891.
Auricula nigra Kuntze, Rev. Gen. **2**: 844. 1891.
Auricula polytricha Kuntze, Rev. Gen. **2**: 844. 1891.
Auricularia nigra Earle, Bull. Torrey Club **26**: 633. 1899.
Auricularia hispidula Farl. Bib. Index **1**: 307. 1905.

Leathery-gelatinous, peziza-shaped at first, becoming cup- or ear-shaped, or foliaceous, erect, sessile, or slightly stipitate, one or several lobed, up to 10 cm. in diameter, tough even when moist; sterile surface external in cup forms, superior in foliaceous forms, densely tomentose with hairs longer than those of *A. Auricula,* red-brown when moist, becoming usually light gray or tan when dry resembling chamois, but sometimes red-brown or almost black when old, not usually wrinkled but sometimes appearing quilted, usually pleated near place of attachment, zoneless, margin frequently turned under; hymenium interior or inferior, red-brown, becoming black when dry, usually smooth, sometimes papillate; spores typical of the genus, $14–15 \times 5–7\ \mu$.

TYPE LOCALITY: Jamaica.

HABITAT: On dead wood.

DISTRIBUTION IN NORTH AMERICA: Alabama, southern Florida and the tropics.

This plant differs from *A. Auricula* in its tougher texture, longer and lighter hairs, and unwrinkled sterile surface. There are two common forms which most writers have considered separate species: *A. nigra,* forming cups; and *A. polytricha,* spreading into lobes. Montaigne (Pl. Cell. Cuba, 365. 1841) notes that young specimens are cup-shaped at first, and then expand. This

fact was exemplified in several of the collections examined, in one of which (Cuba, Earle & Murrill 102) little cups were seen growing from old ear-shaped pieces. Furthermore, comparatively few of the *A. nigra* forms showed spores, thus indicating that the plants were probably immature. The spores when present were like those of *A. polytricha.*

3. **Auricularia mesenterica** (Dicks.) Pers. Myc. Eur. **1**: 97. 1822

Helvella mesenterica Dicks. Crypt. **1**: 20. 1785.
Helvella tremellina Sw. Prod. 149. 1788.
Thaelaephora mesenterica Gmel. Syst. Nat. **II.**, **2**: 1440. (1792.)
Merulius mesentericus Schrad. Sp. 138. 1794.
Thelephora tremellina Sw. Fl. Ind. Occ. 1935. 1806.
Auricularia ornata Pers. in Freyc. Voy. 177. *pl. 2, f. 4.* 1826.
Auricularia lobata Sommerf. in Mag. Nat. Vidensk. 1827.
Phlebia mesenterica Fr. El. 154. 1828.
Patila mesenterica Kuntze, Rev. Gen. **2**: 864. 1891.
Patila lobata Kuntze, Rev. Gen. **2**: 864. 1891.

Tough, not swelling much with moisture, when young peziza-like with hairy margin, becoming resupinate or shelving, attached posteriorly but not stipitate, up to 15 cm. in length, 11 cm. in breadth, and 4 mm. in thickness; upper surface sterile, wholly or partly tomentose in distinct zones of light- and dark-brown or red shading to greenish or tan at the edge, sometimes showing bare zones, margin usually in rounded lobes, frequently turned under; hymenium inferior, red-brown, becoming almost black when dry, when mature wrinkled like a mesentery, often frosted or covered with a yellow bloom; spores typical of the genus, $10–12 \times 5–6\,\mu$.

TYPE LOCALITY: For *Helvella tremellina* Sw., Jamaica.

HABITAT: On dead and decaying wood.

DISTRIBUTION IN NORTH AMERICA of specimens examined: West Indies, Central America, and the Philippines. It is reported also from Maine, Massachusetts, Rhode Island, and North Carolina.

EXSICCATI: Cavara, Fungi Longob. *12;* Roum. Fungi Sel. *7203;* Moug. & Nestl. Stirp. Crypt. Vog.-Rhen. *492*; Rab.-Winter Fung. Eur. *3132*.

ILLUSTRATIONS: Hussey, Ill. Brit. Myc. **2**: *pl. 6;* Mich. Gen. *pl. 66, f. 4.*

A. mesenterica resembles a *Stereum.* It differs from *A. nigrescens* in having zones and a wrinkled hymenium. The hairs, too, are longer and darker in color, and the whole plant lies closer to the surface from which it grows. The form having mixed bare and hairy zones was formerly called *A. lobata.* Among the specimens examined, however, were several which showed both the hairy and the mixed zones in the same collection, thus confirming the theory of Montagne (Pl. Cell. Cuba 373. 1841) and of others, that they belong to the same species.

A. tremelloides Bull. (Champ. *pl. 290.* 1786) is often considered a synonym, but the illustration shows a crater-like form with alveolate folds on the outside. If this, however, is *A. mesenterica,* it and its dependent species, *A. corrugata* (Relh.) Sowerb. (Brit. Fung. *pl. 290.* 1803) and *Tremellidium tremelloides* (Bull.) Chev. (Fl. Gen. **1**: 92. 1826) should be added to the above list.

SUMMARY

Auricularia Auricula (L.) Underwood includes forms sometimes known as *A. sambucina* Mart. and as *A. ampla* Pers. Probably *A. auriformis* (Schw.) Earle and possibly half a dozen other foliaceous species also belong here. *A. Auricula* differs from *A. nigrescens* in possessing a thinner texture, shorter and darker hairs, and veins upon the sterile side. As compared with *A. mesenterica* it is foliaceous rather than resupinate or shelving, is much thinner, has fewer and shorter hairs and is zoneless.

A. nigrescens (Sw.) Farlow comprises *A. nigra* (Fries) Earle (cup-shaped) and *A. polytricha* (Mont.) Sacc. (lobed) besides the less known species of *Exidia purpurascens* Jungh. and *A. hispidula* (Berk.) Farlow. It differs from *A. mesenterica* in its absence of zones, in its shorter and lighter hairs, in its smooth hymenial surface, and in its more expanded shape.

A. mesenterica (Dicks.) Pers., *A. lobata* Sommerf., and *A. ornata* Pers. are the same species, and it is probable that *A. tremelloides* Bull. and *A. corrugata* (Relh.) Sowerb. also belong here.

The collections examined are those in the herbarium of the New York Botanical Garden. Most of them were obtained recently from the tropical portions of this country, but there are specimens from foreign exsiccati also, and from other places in North America which have been noted above.

NEW JERSEY STATE NORMAL SCHOOL,
MONTCLAIR, N. J.

A FUSARIUM DISEASE OF THE PANSY

F. A. Wolf

(With Plate 18, Containing 4 Figures)

The pansy, *Viola tricolor* L., seems to be affected by only a few widely distributed fungi. According to Saccardo's "Sylloge Fungorum," the following fungi are known to occur on the pansy in various parts of the world: *Asteroma latebrarum* Grogn., France; *Catharinia americana* (Ell. and Ev.) Sacc., America; *Cercospora Violae-tricoloris* Br. and Cav., Italy; *Oidium Violae* Pass., Italy; *Peronospora Violae* De Bary, Germany, Britain, America; *Phyllosticta Violae* Desm., Germany, Hungary, Italy, Britain, France; *Puccinia Violae* (Schum.) DC., Europe, Asia, America; *Ramularia agrestis* Sacc., Germany, Italy; *Ramularia lactea* (Desm.) Sacc., Germany, Hungary, Italy, France, Britain; *Synchitrium aureum* Schroet., Europe, America; *Urocystis Violae* (Sow.) Fisch., Germany, Britain, Holland, Italy, France; *Phoma Violae-tricoloris* Diedicke, Germany; *Cladochytrium Violae* Berlese, Italy; *Colletotrichum Violae-tricoloris* Smith, America.

Most of these fungi occur on the leaves, several of them being saprophytic or else appearing only on languid or dying leaves. The violet rust, *Puccinia Violae,* which is parasitic on all of the aërial parts of the plant, is perhaps the most common. The violet smut, *Urocystis Violae,* appears on the petioles and leaves and has been generally reported from Europe. *Colletotrichum Violae-tricoloris* causes a spotting of the leaves very similar in appearance to the common leaf-spot of the violet and also affects the petals, causing them to die along the margins and often inhibiting their development so that the flowers are malformed. *Cladochytrium Violae,* one of the Chytridineae, is parasitic on the roots of pansies in Italy, forming its spores within the tissue of the host. It is only in extreme cases that the entire plant or entire beds are killed by the ravages of any of these forms, although some parts of the plants are often badly affected.

During the past two years a stem and root disease has been

observed at Lincoln, Nebraska, which has been found to be due to a hitherto undescribed fungus. The disease has proved very destructive, hence its consideration is of economic importance.

The disease is characterized by the sudden dying of the plants. Individuals which are apparently healthy will in a few days be dry and dead. When one of these is pulled up, a dark, slightly sunken area on the stem just at the surface of the ground is apparent. The root-system is destroyed so that only stubs of the main roots are left, the smaller parts having been disintegrated. Several entire beds were observed to be thus destroyed, the dying occurring in the month of July.

On July 12, 1907, plants from a bed which was then almost completely lost, were brought into the laboratory. The stems were first washed in tap-water and then dipped for a moment in a mercuric chloride solution 1 : 1000. The outer parts were then removed with a sterile scalpel and a portion of the inner tissue from one of the diseased areas was placed on glucose agar plates. When proper precautions were observed to prevent contamination, these plates gave in every instance pure cultures of a *Fusarium*.

The species of *Fusarium* have been generally regarded as saprophytic. Within the last few years, quite a number have been found to be truly parasitic during part of their life, or at least facultative saprophytes. Among these are a flax wilt* reported from North Dakota; a species which destroys green tomatoes† in the field; and another which attacks cultivated peas.‡

In order to determine the mode of life of this species of *Fusarium*, inoculations were made during the summer of 1908. A small portion of the agar with the hyphae and spores was placed just beneath the surface of the ground near the plants, care being taken to inflict no injury to them. In a month these plants had developed the characteristic brown areas on the stems and died, while the check plants remained normal. Planted plates made from the diseased places, using the same care as before to prevent contamination, gave in turn pure cultures of the *Fusarium*. Microscopic examination revealed the presence of fungus fila-

* Bolley, Bull. N. D. Exp. Sta. 50. 1901.

† Smith, Tech. Bull. Mass. Exp. Sta. 3. 1907.

‡ Schikora, Dissertation Berlin, 1–34. 1906.

ments in the stem tissue, and the presence of spores in the center of the stem.

At the same time, a large bed was noticed in which the plants were all killed, which on examination and by cultures proved to be due to the same *Fusarium*.

Since no species of *Fusarium* have been described as occurring on the pansy or other members of the violet family, the name *Fusarium Violae* is proposed for this species, which is characterized as follows:

Fusarium Violae sp. nov.

Parasitic on the stems and roots of *Viola tricolor*, causing the formation of dark, sunken areas on the stems and the destruction of the root-system. Macrospores hyaline, fusiform-falcate, 28–38 μ long and 4–6 μ wide, 3–5-septate. Sporodochia borne within the stems. In cultures, the hyphae are white and cottony, and the microspores, which are 8.5–12.5 $\times$ 2–3.5 μ, are formed profusely from short side branches. In hanging drop cultures, these spores are capable of very vigorous growth, forming much-branched hyphae.

Hyphis mycelii hyalinis, 4–7 μ diam., irregulariter ramosis, matricem truncorum et radicium penetrantibus; sporodochiis intus, forma indefinita. Macroconidiis hyalinus, fusiformibus falcatiis, 28–38 $\times$ 4–6 μ, 3–5 septatis; microconidiis continuis, 8.5–12.5 $\times$ 2–3.5 μ, e conidiophorum ramulis brevibus oriundis.

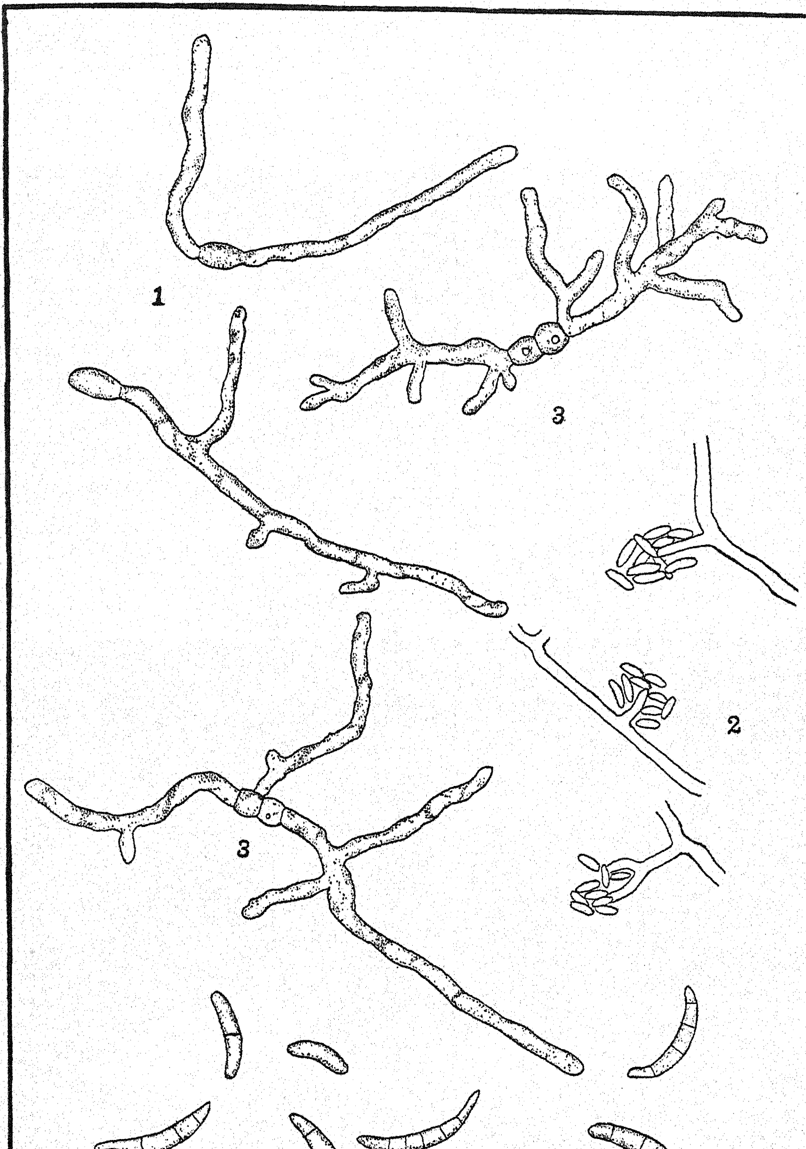
Hab. in truncis vivis et radicibus *Violae tricoloris*, quam destruit; in truncis maculis brunneis vel nigris factis, et radicibus destructis.

One factor was observed in connection with this fungus which might lead to its control. The pansies were destroyed only in those beds which had been fertilized with barnyard manure just previous to planting. Other beds which were not thus enriched before planting were normal. If due precaution is taken that the fertilizers are perfectly decomposed and mixed with the soil before the plot is used for a pansy bed, no injury may be expected. This can, perhaps, be best accomplished by applying the fertilizers in the season previous to the one in which the ground it to be used for pansies.

SCHOOL OF BOTANY,
UNIVERSITY OF TEXAS,
AUSTIN, TEX.

EXPLANATION OF PLATE XVIII

Fig. 1. Germination of microconidia.
Fig. 2. Formation of microconidia as shown in hanging-drop cultures.
Fig. 3. Germination of macroconidia.
Fig. 4. Various forms of macroconidia.



FUSARIUM VIOLAE WOLF

NOTES ON UREDINEAE—V

E. W. D. Holway

Puccinia Porteri Peck

This species was collected in Colorado by J. M. Coulter and the host reported as *Veronica alpina*. The type has recently been examined and found to be *Puccinia Holboellii*, on some crucifer, probably *Arabis*.

Puccinia albulensis P. Magn.

This is the name by which the common American *Puccinia* on *Veronica alpina* must be known. It is very common in the Canadian Mountains, occurring above timber line or on the moraines near the ice.

Puccinia rhaetica Ed. Fischer

This species has not been hitherto reported for North America, but it is abundant at about 6,500 feet elevation on Mt. Ranier, growing on *Veronica Cusickii*.

Puccinia trifoliata E. & E.

This proves to be *Puccinia Osmorrhizae* C. & P., on *Osmorrhiza* sp. It was collected at Seattle, Washington, by C. V. Piper and reported to be on *Tiarella trifoliata*.

Puccinia pallida Tracy

This is *Puccinia Anemones-virginianae* Schw., on some *Anemone*. It was collected in Wisconsin by S. M. Tracy and published as on *Osmorrhiza*.

Puccinia Oregonensis Earle

This species was collected in Oregon by Moses Craig, said to be on *Sanicula bipinnata*. The packets contain the fruit of the *Sanicula* and the leaves of a *Leptotaenia*, with the fungus on the

leaves only. It is *Puccinia asperior* E. & E. The host is probably *Leptotaenia dissecta.*

PUCCINIA LIGUSTICI E. & E.

The type of this species is not on *Ligusticum scopulorum*, but *Oxypolis Fendleri.* It has been collected at Ruby, Colorado, at 9,500 feet by C. F. Baker, on *Oxypolis.* It also occurs on species of *Ligusticum, Carum,* and *Angelica.* The teleutospores are not smooth, as described, but have two or three rows of small tubercles. *Puccinia luteobasis* is the same thing, but with more of the oblong spores. Similar forms occur on *Ligusticum,* and, with a large collection, it is easily seen that they cannot be separated. It was published as on an unknown umbelliferous plant. Specimens sent by Professor Bethel, said to be the same as the type, are on *Conioselinum scopulorum* (Gray) C. & R. The type specimen could not be found.

It is very interesting to note, in view of recent discoveries among the heteroecious rusts, that the teleutospores of *Puccinia Ligustici* cannot be distinguished from those of the large-spored form of *Puccinia Bistortae* on *Polygonum.* The latter has been shown to have in Europe its aecidial stage on Umbelliferae. No cultures have been made in this country, but no doubt the same is true here.

PUCCINIA MUSENII E. & E.

This species has very long, slender, 1–3-septate pedicels, and the teleutospores are closely and evenly verrucose, not reticulate. It has been distributed on *Pseudo-cymopterus* as *Puccinia Jonesii* (Pls. Wyo. No. 36, and Crypt. Form. Col. No. 139), and also as *Puccinia Pimpinellae* (Pls. Wyo. No. 7365).

UNIVERSITY OF MINNESOTA,
MINNEAPOLIS, MINN.

A NEW PHALLOID GENUS

William A. Murrill

Protophallus gen. nov.

Peridium epigeal, sessile, globose, of one layer, breaking into irregular fragments at maturity; volva none; mycelium inconspicuous: gleba olivaceous, odorless, attached to hyaline membranes projecting from the inner surface of the peridium at regular intervals and floating free at maturity in a hyaline, gelatinous liquid: spores very minute, ellipsoid, subhyaline under a microscope.

Protophallus jamaicensis sp. nov.

Peridium spherical, white at maturity, 4 cm. in diameter, consisting of a single layer 1 mm. thick, resembling parchment, the entire peridium breaking at the maturity of the spores into several large, irregular pieces; gleba attached to the peridium by thin, radial, hyaline, membranous plates and projecting in elongated, olivaceous, odorless masses nearly or quite to the center of the sporophore, the remaining space being filled at maturity with a homogeneous, hyaline, semigelatinous, odorless liquid; spores very copious, oblong-ellipsoid, smooth, subhyaline under a microscope, $3.5 \times 1.5\ \mu$.

Type collected January 7, 1909, on shaded soil rich in humus on the bank of the Clyde River near Cinchona, Jamaica, at an elevation of 1,600 meters, *W. A. Murrill 567*.

When first observed, this species was thought to be the "egg" of a *Phallus*, but, on making a section, it was found to be quite mature and utterly devoid of a stipe or other elongating tissue. At the first incision, the hyaline liquid exuded, soon followed by lobes of the olivaceous, sporogenous tissue, which floated free like the gills of a fish or the mantle of an oyster. The liquid resembled the white of an egg, but poured out in large drops like semi-fluid jelly. It was probably the result of deliquescence. The membranous plates to which the spore-masses were attached were as regular in arrangement as the partitions of an orange, but they did not extend to the center. Miss Taylor, who was study-

ing at Cinchona at the time, placed a section of the gleba under her microscope and made a pencil sketch of it for me. She found the sterile threads to be hyaline, septate, interwoven, and slightly larger than the spores.

The remains of another specimen were found near the first, and these served to indicate the method of spore dissemination, which is evidently by means of rain. There is no odor about the plant to attract insects and no stipe to lift the gleba in air; when the spores are mature, the interior tension evidently ruptures the weakened peridium and allows the liquid containing the countless minute spores to escape, when the frequent rains effect their wide distribution.

The generic name assigned refers to the resemblance of this species to the "egg," or undeveloped stage, of a species of *Phallus*. The affinities of the genus appear to be with *Phallogaster*.

Since the above was written, Miss Taylor has brought in three specimens collected by her on the same spot as the types. They all show a single mycelial cord attaching the fruit-body to the underground mycelium. In the young stages the peridium appears to be avellaneous becoming white at maturity.

NEW YORK BOTANICAL GARDEN

THE LACTARIAE OF NORTH AMERICA—FASCICLES I AND II*

GERTRUDE S. BURLINGHAM

1. LACTARIA PIPERATA (L.) Pers. Tent. Disp. Meth. Fung. 64. 1797

Agaricus piperatus L. Sp. Pl. 1173. 1753.
Agaricus Listeri With. Brit. Pl. ed. 2. 3: 288. 1792.

HABITAT: In oak woods or groves.

DISTRIBUTION: In the eastern and southern United States, in the middle west, and in California.

2. LACTARIA PERGAMENA (Sw.) Fries, Epicr. Myc. 340. 1838

Agaricus pergamenus Sw. Kongl. Sv. Vet. ac. Handl. **II.** 30: 90. 1809.

HABITAT: In oak woods.

DISTRIBUTION: In the United States east of the Mississippi.

3. LACTARIA VELLEREA Fries, Epicr. Myc. 340. 1838

Agaricus vellereus Fries, Syst. Myc. **I.**: 76. 1821.

HABITAT: In rather open deciduous woods.

DISTRIBUTION: In the eastern United States from Maine to Alabama.

4. LACTARIA DECEPTIVA Peck, Ann. Rep. N. Y. State Bot. 38: 125. 1885

HABITAT: In woods under or near hemlock trees; only rarely in oak-chestnut woods.

DISTRIBUTION: In the eastern United States from Maine to Alabama.

* Most of the specimens in these two fascicles are accompanied by photographs of the living plants.

5. LACTARIA GLAUCESCENS Crossl. Nat. **1900**: 5. 1900

HABITAT: On the ground in sandy loam or in vegetable soil, oak-chestnut woods.

DISTRIBUTION: Pisgah Forest, North Carolina, at 1,000 meters elevation.

6. LACTARIA TORMINOSA (Schaeff.) Pers. Tent. Disp. Meth. Fung. 64. 1797

Agaricus torminosus Schaeff. Fung. Bav. Icon. **4**: 7 (index). 1774.
Lactaria villosa* Clements, Bot. Surv. Neb. **4**: 20. 1896.

HABITAT: In either coniferous or deciduous woods.

DISTRIBUTION: From Maine to Alabama, and west to Colorado and Nebraska.

7. LACTARIA RESIMA Fries, Epicr. Myc. 336. 1838

Agaricus resimus Fries, Hym. Eur. 472. 1821.

HABITAT: In mixed woods, chiefly in mountainous regions.

DISTRIBUTION: New York; Windham County, Vermont, at an elevation of about 500 meters.

8. LACTARIA SPECIOSA Burl. Mem. Torrey Club **14**: 34. 1908

HABITAT: In sandy soil, oak-chestnut woods, in dry as well as wet weather.

DISTRIBUTION: North Carolina, Tennessee, and Virginia, from 670 to 1,200 meters elevation.

9. LACTARIA CROCEA Burl. Mem. Torrey Club **14**: 37. 1908

HABITAT: In vegetable mold and dead leaves, oak-chestnut woods.

DISTRIBUTION: Pisgah Forest, North Carolina, at 1,000 meters elevation.

10. LACTARIA RUSTICANA (Scop.) Burl. Mem Torrey Club **14**: 27. 1908

Agaricus rusticanus Scop. Fl. Carn. **2**: 452. 1772.
Agaricus pyrogalus Bull. Herb. Fr. *pl. 529, f. 1.* 1791. Hist. Champ. **I.**: 487.

* *Lactaria* is here used uniformly, although spelled *Lactarius* by most authors.

Lactarius pyrogalus Fries, Epicr. Myc. 339. 1838.

HABITAT: In open grassy places in woods.

DISTRIBUTION: New York, Vermont, Ohio, and Maryland.

11. LACTARIA AGGLUTINATA Burl. Mem. Torrey Club **14**: 42. 1908

HABITAT: In oak-chestnut woods.

DISTRIBUTION: Pisgah Forest, North Carolina, at an elevation of 1,000 meters.

12. LACTARIA TURPIS (Weinm.) Fries, Epicr. Myc. 335. 1838

Agaricus Necator Pers. Syn. Fung. 435. 1801. Not *Agaricus Nector* Bull. Herb. Fr. *pl. 14; pl. 529, f. 2.* 1780.

Agaricus turpis Weinm. Syl. Pl. Nov. **2**: 85. 1828.

Lactarius sordidus Peck, Ann. Rep. N. Y. State Mus. **23**: 119. 1872.

HABITAT: On the ground in mixed woods, often near fir or spruce trees.

DISTRIBUTION: From Maine to Ohio, and probably in North Carolina.

13. LACTARIA ASPIDEOIDES Burl. Bull. Torrey Club **14**: 87. 1907

HABITAT: In a grassy hillside sheep-pasture, near small fir trees.

DISTRIBUTION: Newfane, Vermont.

14. LACTARIA LIVIDORUBESCENS (Batsch) Burl. Mem. Torrey Club **14**: 49. 1908

Agaricus lividorubescens Batsch, Elench. Fung. **2**: 51. *pl. 36, f. 202.* 1789.

Agaricus uvidus Fries, Obs. Myc. **2**: 191. 1818.

Lactaria uvida Fries, Epicr. Myc. 338. 1838.

Lactarius livescens Passerini, Nuovo Giorn. Bot. Ital. **4**: 105. 1872.

HABITAT: On the ground in moist mixed woods.

DISTRIBUTION: Eastern United States as far south as Maryland.

15. LACTARIA INSULSA Fries, Epicr.
Myc. 336. 1838

Agaricus insulsus Fries, Syst. Myc. **I.**: 68. 1821.

HABITAT: On the ground in rather open places in oak-chestnut woods.

DISTRIBUTION: From Maine to Alabama and Missouri.

16. LACTARIA AFFINIS Peck, Rep. N. Y. State
Cab. **23**: 118. 1873

Lactaria platyphylla Peck, Rep. N. Y. State Cab. **23**: 118. 1873.

HABITAT: In mixed balsam and maple woods.

DISTRIBUTION: Maine, Vermont, and Massachusetts.

17. LACTARIA TRIVIALIS Fries, Epicr.
Myc. 337. 1838

Agaricus trivialis Fries Obs. Myc. **I.**: 61. 1815.

Lactaria deflexa Lindblad, Monogr. Lact. Suec. 8. 1855.

HABITAT: In deciduous woods.

DISTRIBUTION: Eastern United States from New Hampshire to North Carolina and west to Tennessee and Missouri.

18. LACTARIA CIRCELLATA Fries, Epicr.
Myc. 338. 1838

Agaricus circellatus Fries, Hym. Eur. 426. 1821.

HABITAT: In moist mixed woods.

DISTRIBUTION: Newfane, Vermont, at an elevation of 500 meters.

19. LACTARIA HYSGINA Fries, Epicr.
Myc. 337. 1838

Agaricus hysginus Fries, Syst. Myc. **I.**: 67. 1821.

HABITAT: In moist woods, especially near spruce trees; often in grassy borders of woods.

DISTRIBUTION: New York, Maine, Newfane and Stratton, Vermont.

20. LACTARIA MUCIDA Burl. Mem. Torrey
Club **14**: 56. 1908

HABITAT: Under hemlocks in moist places.

DISTRIBUTION: Newfane and Stratton, Vermont; Pisgah Forest, North Carolina.

21. LACTARIA DELICIOSA (L.) Fries, Epicr. Myc. 341. 1838

Agaricus deliciosus L. Sp. Pl. 1172. 1753.

HABITAT: In moist woods, especially under firs and hemlocks.

DISTRIBUTION: Eastern United States from Maine to Florida, in Colorado, and probably in California.

22. LACTARIA SUBPURPUREA Peck, Ann. Rep. N. Y. State Mus. **29**: 43. 1878

HABITAT: In moist woods in the vicinity of hemlocks.

DISTRIBUTION: New York, Vermont, Massachusetts, Connecticut, and North Carolina.

23. LACTARIA QUIETA Fries, Epicr. Myc. 343. 1838

Agaricus quietus Fries, Syst, Myc. **I.**: 69. 1821.

HABITAT: In fir and spruce woods as well as in deciduous woods.

DISTRIBUTION: New York and Stratton, Vermont.

24. LACTARIA NITIDA Burl. Bull. Torrey Club **34**: 89. 1907

HABITAT: In moist woods, or open borders of woods.

DISTRIBUTION: Newfane and Stratton, Vermont.

25. LACTARIA OCULATA (Peck) Burl. Bull. Torrey Club **34**: 89. 1907

Lactaria subdulcis oculata Peck, Bull. N. Y. State Mus. **67**: 37. 1903.

HABITAT: Under coniferous trees often in moss.

DISTRIBUTION: New York, Newfane and Stratton, Vermont.

26. LACTARIA MINUSCULA Burl. Bull. Torrey Club **34**: 88. 1907

HABITAT: In moist woods, in moss or on decayed wood, under yellow birches, black gum, and black oak.

DISTRIBUTION: New York, Vermont, and North Carolina.

27. LACTARIA CINEREA Peck, Rep. N. Y. State Bot. **24**: 73. 1872

HABITAT: Under beeches or among beech leaves.

DISTRIBUTION: Eastern United States from Maine as far south as North Carolina.

28. LACTARIA THEIOGALA (Bull.) Fries, Epicr. Myc. 342. 1838

Agaricus theiogalus Bull. Herb. Fr. *pl. 567, f. 2.* 1793. Hist. **1**: 495. 1809.
Hypophyllum lateritium Paulet, Paulet & Léveillé, Icon. Champ. 59. 1855.
Lactaria brevipes Longyear, Rep. Mich. Acad. Sci. **3**: 59. 1901.
Lactaria brevis Peck, Bull. N. Y. St. Mus. **94**: 33. 1905.
Lactaria xanthogalacta Peck, Bull. Torrey Club **34**: 346. 1907.

HABITAT: In dry or moist woods under fir, spruce or oak trees.

DISTRIBUTION: From Maine to Alabama, and in California.

29. LACTARIA HELVA Fries, Epicr. Myc. 347. 1838

Agaricus helvus Fries, Syst. Myc. **I.**: 72. 1821.
Lactaria aquiflua Peck, Rep. N. Y. State Mus. **28**: 50. 1877.
Lactaria aquiflua brevissima Peck, Rep. N. Y. State Mus. **51**: 298. 1897.

HABITAT: In mossy, rather wet woods or marshes.

DISTRIBUTION: From Ontario, Canada to Pennsylvania and probably North Carolina.

30. LACTARIA PECKII Burl. Mem. Torrey Club **14**: 76. 1908

HABITAT: In moist grassy wood-trails, and open places near brooks, or even in bare clay banks, in oak-chestnut woods.

DISTRIBUTION: Long Island, Staten Island, North Carolina, Alabama.

31. LACTARIA ALPINA Peck, Ann. Rep. N. Y. State Mus. **27**: 96. 1875

HABITAT: Borders of woods.

DISTRIBUTION: From New York and Vermont to Alabama.

32. LACTARIA GRISEA Peck, Ann. Rep. N. Y. State Mus. **23**: 119. 1873

HABITAT: In moist mossy places in woods, on the ground or on decaying wood.

DISTRIBUTION: From Maine to New York and Connecticut and in North Carolina.

33. LACTARIA BENSLEYAE Burl. Bull. Torrey Club **34**: 87. 1907

HABITAT: In black moist soil under yellow birch and spruce trees.

DISTRIBUTION: Newfane, Vermont.

34. LACTARIA GLYCIOSMA Fries, Epicr. Myc. 348. 1838

Agaricus glyciosmus Fries, Obs. Myc. **2**: 194. 1818.

HABITAT: On the ground or on decaying wood, in woods.

DISTRIBUTION: New York, Vermont, and Missouri.

35. LACTARIA HIBBARDAE Peck, Jour. Myc. **14**: 2. 1908

HABITAT: On the ground under pine or spruce and fir trees.

DISTRIBUTION: Massachusetts and Vermont.

36. LACTARIA PLINTHOGALA (Otto) Burl. Mem. Torrey Club **14**: 84. 1908

Agaricus azonites Bull. Hist, Champ. **2**: 497. 1809. Herb. Fr. *pl. 567, f. 3.* 1791. Probably not *Lactaria azonites* Gillet.

Agaricus plinthogalus Otto, Versuch. Agar. 75. 1816.

Agaricus fuliginosus Fries, Syst. Myc. **I.**: 73. 1821.

Lactaria fuliginosa Fries, Epicr. Myc. 348. 1838.

Lactaria fumosa Peck, Ann. Rep. N. Y. State Mus. **24**: 74. 1872.

Lactariella azonites (Bull.) Schröt. in Cohn, Krypt.-Fl. Schles. **3**: 544. 1889.

HABITAT: In deciduous or mixed woods.

DISTRIBUTION: Maine, Vermont, New York, Pennsylvania, North Carolina, and Alabama.

37. LACTARIA LIGNIOTA Fries, Monogr. **2**: 177. 1863

Lactaria fuliginosa major Fries, Epicr. 348. 1838.

Lactariella ligniota Schröt. in Cohn, Krypt.-Fl. Schles. **3**: 544. 1889.

HABITAT: On the ground in mossy wet woods, especially under fir trees.

DISTRIBUTION: New York, Vermont, Connecticut, New Jersey, and North Carolina.

38. LACTARIA GERARDII Peck, Ann. Rep. N. Y. State Mus. **26**: 65. 1874

HABITAT: On the ground in woods or groves.

DISTRIBUTION: New York, Vermont, Pennsylvania, District of Columbia, and North Carolina.

39. LACTARIA SALMONEA Peck, Bull. Torrey Club **25**: 369. 1898

HABITAT: In wet swampy places, usually on bare ground that has been overflowed.

DISTRIBUTION: Alabama and Mississippi.

40. LACTARIA LACTIFLUA (L.) Burl. Mem. Torrey Club **14**: 90. 1908

Agaricus lactifluus L. Sp. Pl. 1172. 1753.

Agaricus oedematopus Scop. Fl. Carn. **2**: 453. 1772.

Agaricus testaceous Alb. & Schw. Consp. Fung. 209. 1805.

Agaricus volemus Fries, Syst. Myc. **I.**: 69. 1821.

Lactaria volema Fries, Epicr. Myc. 344. 1838.

HABITAT: In woods or groves, especially in the vicinity of oaks.

DISTRIBUTION: Eastern United States from Maine to Alabama and Mississippi, and west to Indiana and Missouri.

41. LACTARIA HYGROPHOROIDES Berk. & Curt. Ann. Mag. Nat. Hist. III. **4**: 10. 1859

Lactaria distans Peck, Ann. Rep. N. Y. State Mus. **23**: 117. 1873.

HABITAT: Mixed woods.

DISTRIBUTION: From Maine to District of Columbia, and in Mississippi, Missouri, and Indiana.

42. LACTARIA CORRUGIS Peck, Ann. Rep. N. Y. State Mus. **32**: 31. 1880

HABITAT: Moist woods, especially in mixed oak-chestnut-maple woods.

DISTRIBUTION: From New York south to Alabama and Mississippi, and west to Tennessee and Missouri.

43. LACTARIA CAMPHORATA (Bull.) Fries, Epicr. Myc. 346. 1838

Agaricus camphoratus Bull. Herb. Fr. *pl. 567, f. 1.* 1791. Hist. Champ. 493. 1809.

HABITAT: Most abundant in moist mixed woods.

DISTRIBUTION: From New York and Vermont south to Alabama and Tennessee.

44. LACTARIA RIMOSELLA Peck, Bull. N. Y. State Mus. **105**: 37. 1906

HABITAT: In mixed woods, under beech trees, also on bare soil in woods or by roadsides.

DISTRIBUTION: New York and Vermont.

45. LACTARIA SUBDULCIS (Pers.) Fries, Epicr. Myc. 345. 1838

Agaricus lactifluus dulcis Bull. Herb. Fr. *pl. 224, A, B.* 1784.
Agaricus subdulcis Pers. Syn. Meth. Fung. 433, 434. 1801.
Lactaria subseriflua Longy. Rep. Mich. Ac. Sci. **1901**: 57, 59. 1902.

HABITAT: In woods, or on the borders of woods.

DISTRIBUTION: From Maine south to Alabama and Missouri and west to Illinois.

46. LACTARIA ISABELLINA Burl. Bull. Torrey Club **34**: 88. 1907

HABITAT: In leaf-mold or sphagnum, in moist mixed or spruce woods.

DISTRIBUTION: Vermont and North Carolina.

47. LACTARIA PARVA Peck, Ann. Rep. N. Y. State Mus. 29: 44. 1878

HABITAT: On the ground or on decaying wood in moist woods.

DISTRIBUTION: New York, Vermont, and Toronto, Canada.

48. LACTARIA VARIA Peck, Ann. Rep. N. Y. State Mus. 38: 126. 1885

HABITAT: On the ground in moist woods.

DISTRIBUTION: New York, Vermont, Massachusetts, and New Jersey.

49. LACTARIA CHELIDONIUM Peck, Ann. Rep. N. Y. State Mus. 24: 74. 1872

HABITAT: In sandy dry soil under pine or spruce trees.

DISTRIBUTION: New York, Vermont, Connecticut, North Carolina, and Alabama.

50. LACTARIA RUSTICANA (Scop.) Burl. Mem. Torrey Club 14: 27. 1908

HABITAT: In open grassy places in woods.

DISTRIBUTION: New York, Vermont, Ohio, and Maryland.

367 CLIFTON PLACE,
BROOKLYN, N. Y.

A NEW COLOR GUIDE

P. L. Ricker

Several years ago the writer was appointed on a committee with Dr. W. A. Murrill and the late Dr. L. M. Underwood, by the American Mycological Society (now united with the Botanical Society of America) to prepare a color guide adequate to the needs of botanists and mycologists. After working on it for about two years the writer learned of a similar work in preparation by Dr. Robert Ridgway, the well-known ornithologist and author of a Nomenclature of Colors (1886) which contains 186 colors, shades and tints. After a consultation with Dr. Ridgway, and later with the other members of the committee, it was decided to leave the field of color work in favor of Dr. Ridgway. The writer is now glad to announce that Dr. Ridgway has been particularly fortunate in securing competent publishers who state that the work will probably be ready in about six months. The chemist of the firm is an expert in colors and has, in fact, been engaged at odd times for several years in preparing for a similar work. Dr. Ridgway has been at the revision of his old work as his time would permit for about twenty years, and it is safe to say that no similar work has ever been prepared with the same degree of physical and mathematical precision. This will be better understood by those familiar with Michelson's interferometer (an instrument by which it is possible to measure the wave-lengths of all light colors in millionths of a millimeter, a millimeter being 1/25 of an inch), when it is stated that each primary and secondary color in this work is a composite resulting from the measurement in wave-lengths of light of each color as represented in nine standard works upon the subject, the measurements being made by Prof. P. G. Nutting, of the U. S. Bureau of Standards.

The work will contain 64 plates, each with 27 blocks of color, in three rows of nine blocks each, or a total of about 1,350 blocks, the blocks being one-half by one inch, as in his first color work.

These will be named as far as possible, it being manifestly impossible to satisfactorily name all of them, and in addition each horizontal row will be numbered and the vertical rows lettered, intermediate figures and letters between each row being used to represent intermediate shades or tints when that degree of accuracy is necessary. Instead of the degree of variation between blocks of color in various parts of the work being very unequal, as in all previous color guides of any size, the intermediate shades, tints and hues are determined by a uniform scale of percentages by the use of Maxwell's color wheel. There will be a probable edition of 2,500 copies, the volumes being about five and a half by eight inches, and one inch thick. For field use it is expected about 800 of these copies will have their margin trimmed and be bound in a flexible leather binding, easily fitting a man's coat pocket. The price with board covers will be about $5.00. The only work extant which approaches this in any respect is the Repertoire de Couleurs of the Société Francaise des Chrysanthemistes, containing 1,385 color shades and tints, of which only about 365 are named, and no method is provided for designating the others. It consists of two bulky volumes of loose plates in portfolios, many of the intermediate shades, tints and hues are too nearly alike, and a prohibitive import duty brings the price in this country to about $10.00. The paper is also too heavy, and its form is entirely unsuited for field work.

BUREAU OF PLANT INDUSTRY,
WASHINGTON, D. C.

NEWS AND NOTES

Yale University has received from Mrs. Morris K. Jesup $100,000 to establish the Morris K. Jesup chair of agriculture in the Forestry School.

Georgia has appropriated $10,000 for educational work at farmers' institutes in the state.

A new agricultural college and research institute has been opened at Coimbatore in British India.

Benjamin F. Lutman (A.B. Missouri, 1906; Ph.D. Wisconsin, 1909), recently assistant in botany in the University of Wisconsin, has accepted a position as assistant botanist in the Vermont Experiment Station.

Dr. W. A. Murrill sailed for Mexico on December 2, to continue his studies of tropical American fungi. He was accompanied by Mrs. Murrill.

The new College of Agriculture of the University of the Philippines, opened last June with a registration of about sixty. E. B. Copeland is dean and professor of botany; H. Cuzner is professor of agronomy.

The University of Wisconsin has created a new department of plant pathology, and has appointed as professor in charge Dr. Lewis Ralph Jones, of the University of Vermont. Professor Jones has been botanist of the Vermont Experiment Station since 1890. During this period he has carried on research work in the bureau of plant industry in Washington, and in Europe. In

addition to gaining a high reputation as a teacher, he has occupied a field of wide service in Vermont in developing the work of the Vermont Botanical Club and the state forestry department, in securing for the University the Pringle Herbarium with Dr. Pringle as curator, and recently in organizing a new department of teaching. As a public-spirited citizen and as an instructor, he holds a secure position in the esteem and affection of the students and the people of the state. Professor Jones will remain in Burlington until January, and enter on the work of his new appointment at the beginning of the second semester.

In the *Botanical Gazette* for October, 1909, G. F. Atkinson describes and copiously illustrates a remarkable species of *Amanita* from California, collected and photographed by Mrs. V. G. Ballen. The name assigned, *A. calyptroderma,* refers to the fact that the calyptra of the volva fits like a skin over the center of the pileus.

A very helpful guide to Saccardo's "Sylloge Fungorum" has recently appeared under the title "Genera of Fungi," by Dr. F. E. Clements, published by the H. W. Wilson Co., Minneapolis, Minnesota. This work includes keys to the genera and larger groups found in Saccardo's work and also covers Rehm's "Discomyceten" and the lichens of Engler and Prantl's "Pflanzenfamilien."

A number of woody fungi collected by Professor S. Kusano in Formosa were recently sent in for determination and have been added to the Garden herbarium. The collection contains few novelties, most of the species having been received before, either from the Philippines or from Japan.

A description list of the hymenomycetes found in the vicinity of Chicago, by Dr. W. S. Moffatt, has recently been published as Bulletin no. 7, part 1, of the Natural History Survey of The Chicago Academy of Sciences. The pamphlet contains 156 pages

of text and 24 plates. It not only lists the known species of the region, but also brings together in compact form descriptive notes on these species that have been scattered through many publications. Students and collectors in almost any region of the northern United States would find it helpful on this account.

Mr. H. C. Beardslee, of Asheville, North Carolina, contributes the following notes on *Boletus rubinellus* Peck:

"This species occurs quite regularly at Asheville, though always sparingly, and has been kept under observation for several years. As found here it is a very attractive little plant, answering well to Peck's description except that the spores are a little smaller than the dimensions given by him. In my plant, they measure 9–10 $\times$ 4 μ. It seems to be clearly distinct from *B. piperatus*, to which it has little resemblance, and distinct enough from *B. communis*. The question that I would raise concerning it is that of its relationship to *B. rubinus* Smith.

"The description given of Smith's plant does not apply in all points to our *Boletus*. *B. rubinus* is placed with the Subtomentosi, but this will surprise no one who has collected our plant. It has all the marks of that section and if collected in dry weather would be confidently referred to it, although it is viscid in wet weather. The spores of *B. rubinus* are said to be oval, almost round, 6 $\times$ 5 μ. This is not true of the American plant, but other points in the description strongly suggest it. Mr. Rea has kindly examined my specimens and photographs and is of the opinion that it is the same as Smith's species. It would seem that a careful comparison of these species should be made, especially with reference to their microscopic features. Personally, I do not believe the two species are distinct."

Several new species of gill-fungi and three new species of coral-fungi are described by Professor G. F. Atkinson in *Annales Mycologici* for August, 1909.

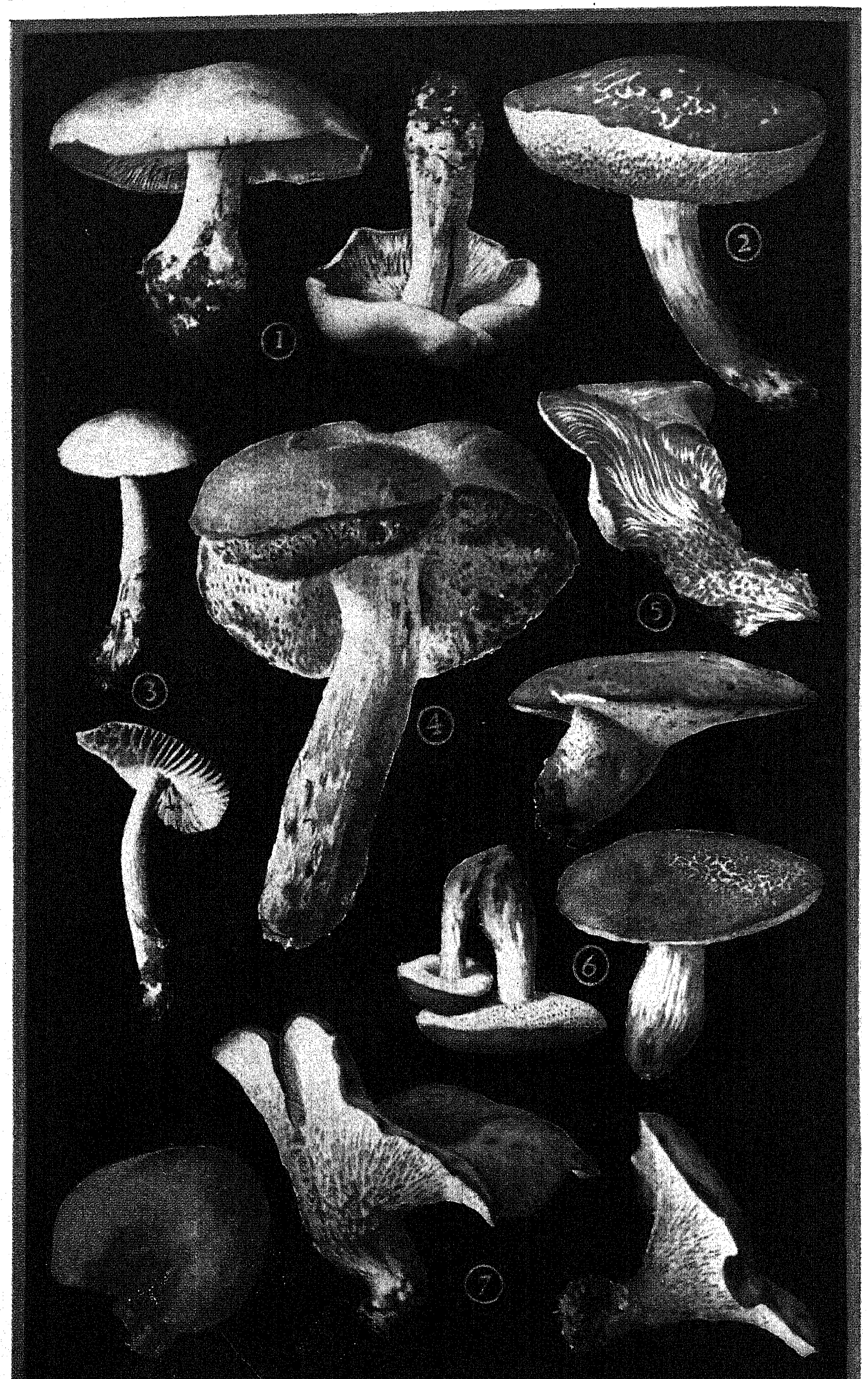
The thirteenth annual fungus foray of the British Mycological Society was held at Baslow, Derbyshire, England, from Septem-

ber 27 to October 2, 1909. The members collected during each day and met for the discussion of interesting specimens and the reading of papers in the evenings.

The fourth annual report of the Forest Park Reservation Commission of New Jersey, published in September, 1909, includes an illustrated article of twenty-four pages on the planting and care of shade trees, by Alfred Gaskill, forester; one of sixteen pages on insects injurious to shade trees, by John B. Smith, state entomologist; and one of twenty pages on the fungi of native and shade trees, by Byron D. Halsted, botanist of the State Experiment Station. These three articles probably constitute the most comprehensive and helpful publication on the care of American shade trees to be obtained anywhere.

Arrangements are being made to hold the first meeting of the American Phytopathological Society in connection with the American Association for the Advancement of Science at Boston, Massachusetts, during Convocation Week, December 27, 1909, to January 1, 1910, at which time questions relating to the future policy of the Society and its relations to Section G of the American Association for the Advancement of Science will be definitely determined.

The biology of *Armillaria mucida* Schrad. is the subject of a paper by C. E. C. Fischer in the *Annals of Botany* for October, 1909. The fungus was artificially grown from spores, and several fruitless attempts were made to introduce it as a parasite into the beech tree, on which the sporophores are commonly found. Owners of beech forests are advised by the author to keep wounds on their trees covered with an antiseptic, and to destroy dead infected timber and young sporophores before they are able to shed spores.



ILLUSTRATIONS OF FUNGI

MYCOLOGIA

VOL. II MARCH, 1910 No. 2

ILLUSTRATIONS OF FUNGI—VI.

WILLIAM A. MURRILL

The species represented on the accompanying plate belong chiefly to the Boletaceae, a family of fleshy, pore-bearing fungi containing about seventy-five North American species, distributed in eleven genera. Most of the members of this family are edible, but, owing to the difficulty of distinguishing the few inedible species, they should be selected with the greatest care when collected for the table.

Tricholoma personatum (Fries) Quél.

MASKED TRICHOLOMA. BLEWITS

Plate 19. Figure 1. $\times \frac{1}{2}$

Pileus thick, firm, convex to expanded, 5–12 cm. broad; surface moist, glabrous, lilac or purple, fading to grayish, becoming slightly brownish on the disk; margin inrolled and frosted when young, glabrous and often irregular with age; flesh white, firm, pleasant to the taste; gills crowded, rounded behind, free or nearly so, violet or lilac, becoming dull-colored with age; spores ellipsoid, smooth, dingy-white, dull pinkish in mass, 7–10 μ long; stem short, solid, often bulbous at the base, fibrillose to glabrous, lilac or violet, 3–6 cm. long, 1.5–3 cm. thick.

This species is of good flavor and not easily confused with dangerous species. It may be found in open woods or among long grass in rich fields during the autumn months. Its large size and the violet or lilac tint of all its parts should distinguish it from most other species. In large, mature specimens, the flesh becomes soft and readily absorbs water during wet weather,

[MYCOLOGIA for January, 1910 (2: 1–42), was issued Jan. 1, 1910]

which somewhat changes the appearance of the mushroom and lessens its value for edible purposes.

Ceriomyces communis (Bull.) Murrill

COMMON CERIOMYCES. GOLDEN-FLESH BOLETUS

Plate 19. Figure 2. $\times \frac{2}{3}$

Pileus convex to expanded, depressed at times with age, gregarious, 4–8 cm. broad, 1–2 cm. thick; surface dry, tomentose to floccose-squamulose, often rimose-areolate, variable in color, usually some shade of red or purple, fading to brown; margin entire, fertile; context yellowish-white to flavous, reddish beneath the cuticle, usually changing slowly to greenish or bluish when wounded, especially near the tubes, taste mild; tubes adnate, convex in mass, slightly decurrent, becoming much depressed at times with age, yellow or greenish-yellow, changing to greenish-blue when wounded, mouths large, angular, irregular, 1–2 to a mm.; spores fusiform, smooth, olivaceous when fresh, fading to pale-brownish, $11–13 \times 4–5\ \mu$: stipe subcylindric, often contorted, tapering at the base, flavous above, red or streaked with red below, longitudinally furrowed, glabrous or minutely scurfy, solid, sometimes yellow within at the base, 3–8 cm. long, 0.3–1.5 cm. thick.

This species is, in most localities, the most common and abundant member of the family, being the first to appear on mossy banks in early summer and continuing to fruit until late autumn. It is usually rather small, with reddish cap and stem, and large, yellow tubes, which turn blue when wounded. It is sometimes difficult to secure specimens for the table on account of a whitish mould which appears to be particularly prolific on this species.

Marasmius oreades (Bolt.) Fries

FAIRY-RING MUSHROOM. SCOTCH BONNETS

Plate 19. Figure 3. $\times \frac{2}{3}$

Pileus convex to expanded, often umbonate, slightly striate at times when moist, fleshy-tough, drying easily, 2–5 cm. broad; surface glabrous, buff or tawny, fading with age or on drying; flesh thin, white, of pleasant odor and taste; gills broad, distant, free or adnexed, yellowish-white; spores subellipsoid, smooth, hyaline, $7–9\ \mu$ long; stem cylindrical, rather slender, solid, tough, yellowish-white, villose-tomentose, 5–8 cm. long, 2–4 mm. thick.

This very excellent little species is to be looked for in pastures during spells of wet weather in late summer or autumn. Its habit of growing in circles will aid one in recognizing it. I have found it much more abundant in England and other parts of Europe than in this country. If found in sufficient quantity for table use, it should be cooked for some time, owing to its tough texture.

Ceriomyces subsanguineus (Peck) Murrill

TESTACEOUS CERIOMYCES

Plate 19. Figure 4. $\times \frac{2}{3}$

Pileus convex to plane or slightly depressed, gregarious or cespitose, 5–11 cm. broad, 1–3 cm. thick; surface usually glabrous, somewhat viscid, testaceous, fading to ochraceous or isabelline, rarely pulverulent or partially rimose-areolate; margin obtuse, beveled; context thick, white, firm, changing slightly to very pale-roseous when wounded, slightly harsh or bitterish at first to the taste, but becoming mild; tubes truly adnate, separating slightly in old plants, decurrent, 5–7 mm. long, pale-yellowish, becoming brownish to purplish when bruised, mouths of medium size, edges thin; spores oblong-ovoid, smooth, very pale-yellowish, $8–9 \times 3.5–4.5\,\mu$: stipe rather short, thick, tapering downward to a small radicate base, 4–7 cm. long, 1–2 cm. thick, nearly white, finely scurfy, sometimes reddish-dotted, flavous and reticulate above, solid, firm and white within.

This species is very rare, being known only from three localities, one in Pennsylvania and two in New Jersey. It grows under beech trees or in beds of moss. The conspicuous reddish or orange color of the cap soon fades, especially in bright light.

Fistulina hepatica (Huds.) Fries

BEEFSTEAK FUNGUS. VEGETABLE BEEFSTEAK

OAK TONGUE. CHESTNUT TONGUE. BEEF TONGUE

Plate 19. Figure 5. $\times \frac{1}{3}$

Pileus large, fleshy, very juicy, dimidiate to flabelliform, 5–15 cm. broad; surface dark-red, somewhat sticky when moist, radiate-striate with age, margin entire to lobed; flesh thick, soft, tough, streaked with dark- and light-reddish lines, acid to the taste; tubes at first short, yellowish or pinkish, becoming 3 mm. long, plainly distinct from one another, and dull-ochraceous with

age; spores ellipsoid, smooth, yellowish, 5–7 μ long; stipe usually short and thick, lateral, colored like the pileus, often reduced to a mere tubercle and sometimes wanting.

This species occurs on decaying trunks and stumps of chestnut, oak, and certain other deciduous trees in this country and in Europe. On account of its resemblance to a piece of beefsteak, it has long been recognized and used for food. It should be thoroughly cooked, and, if the acid flavor is objectionable, sodium carbonate should be added during the process of cooking. I have found this fungus much more common on chestnut than on oak, and I have noticed that foreigners regularly visit old chestnut stumps and trunks in the vicinity of New York during late summer and autumn to obtain it. Since the chestnut trees have all been killed by the canker, the beefsteak fungus should appear in great quantity.

Ceriomyces subtomentosus (L.) Murrill

SUBTOMENTOSE CERIOMYCES. YELLOW-CRACKED BOLETUS

Plate 19. Figure 6. $\times \frac{3}{8}$

Pileus convex to expanded, 4–10 cm. broad; surface dry, tomentose, often rimose-areolate, yellowish-brown, reddish-brown or subolivaceous; margin entire, often involute when young; context white or yellowish, unchanging, yellow beneath the cuticle, taste mild; tubes adnate or slightly depressed, often becoming nearly free, yellow, unchanging when wounded, greenish-yellow at the maturity of the spores, mouths large, irregular, sometimes compound; usually angular; spores greenish when fresh, fading to yellowish-brown, subfusiform, smooth, 10–12 $\times$ 4–5 μ; stipe ventricose or nearly equal, tapering below, furfuraceous to glabrous, even, or wholly or partially reticulate, pale-yellow or slightly brownish, often flavous above, reddish-brown when bruised, solid, white or yellowish within, 4–6 cm. long, 0.5–1.5 cm. thick.

This species, like the golden-flesh boletus, is generally distributed in deciduous woods throughout Europe and temperate North America and is often eaten. The cap is usually yellowish-brown or olive-tinted and the stem and large tubes are yellow, the latter not becoming blue when wounded, as is the case in *C. communis.*

Boletinellus merulioides (Schw.) Murrill

ECCENTRIC-STEMMED BOLETINELLUS

Plate 19. Figure 7. $\times \frac{2}{3}$

Pileus thin, irregular, usually lobed, more or less deeply depressed at maturity, gregarious, 5–12 cm. broad; surface dry, minutely tomentose, dull reddish-brown; margin undulate or deeply lobed: context 5–10 mm. thick, yellow, changing slowly to bluish-green when wounded, having a musty or unpleasant odor; tubes decurrent, hymenium honey-yellow when young, becoming dull-yellow with age, often changing slightly to blue when wounded; tubes formed by radiating lamellae 2–3 mm. apart, branching and connected by numerous irregular veins of less prominence; spores subovoid to ellipsoid, smooth, yellow to brownish-ochraceous, 8–11 $\times$ 5–7 μ: stipe lateral or eccentric, tough, expanded into the pileus, reticulate at the apex by the decurrent walls of the tubes, concolorous, clothed like the pileus, hollow, 1–3 cm. long, 8–12 mm. thick.

This species occurs throughout the eastern United States in low places or on shaded banks, especially about stumps and decaying roots. It is dull reddish-brown above and yellow below, with very large tubes and eccentric or lateral stem. It is not generally considered edible.

THE HYPOCREALES OF NORTH AMERICA—III.

Fred J. Seaver

(With Plates 20 and 21, Containing 37 Figures)

Family II. HYPOCREACEAE

Stromata conspicuous, seated directly on the substratum or springing from a sclerotium in the bodies of insects, fungi, or the ovaries and stems of plants, effused without definite margin, patellate, substipitate or erect; perithecia partially to entirely immersed in the stroma, rarely subsuperficial (especially in aged specimens); asci cylindrical or clavate, 8–16-spored; spores subglobose to filiform, simple or compound, hyaline or colored.

Stroma seated directly on the substratum, usually patellate or effused, rarely clavate and erect; spores rarely filiform.	Hypocreae.
Stroma springing from a sclerotium, usually erect and clavate, rarely depressed; spores filiform.	Cordycepteae.

Tribe III. Hypocreae

Stromata patellate or effused, rarely clavate and erect, not springing from a sclerotium; perithecia partially to entirely immersed, papillate, with the neck often protruding; asci cylindrical or clavate, 8–16-spored; spores subglobose, elliptical, fusiform or filiform, simple or compound, hyaline or simple.

Asci 16-spored (by the separation of each original spore into two subglobose cells).	
Stroma patellate or effused.	
Spores hyaline.	23. Hypocrea.
Spores becoming greenish or brownish.	24. Chromocrea.
Stroma clavate and vertical.	25. Podostroma.
Asci 8-spored; spores elliptical, fusiform or filiform.	
Stroma with stilbum-like outgrowths.	26. Stilbocrea.
Stroma without stilbum-like outgrowths.	
Spores elliptical to fusiform.	
Spores simple or doubtfully septate.	
Spores colored.	27. Chromocreopsis.
Spores hyaline.	

Stroma very scant; perithecia subsuperficial. 28. BYSSONECTRIA.
Stroma profuse; perithecia immersed. 29. PECKIELLA.
Spores 1-septate, fusiform or subfusiform.
Stroma cottony or subfleshy; spores fusiform. 30. HYPOMYCES.
Stroma fleshy; spores elliptical. 31. HYPOCREOPSIS.
Spores filiform.
Perithecia enclosed in a membranaceous wall. 32. OOMYCES.
Perithecia not enclosed in a membranaceous wall.
Stroma very scant, cottony, white. 33. BARYA.
Stroma subfleshy, of variable color.
Stroma sheathing, on stems of grasses. 34. TYPHODIUM.
Stroma patellate or subpatellate. 35. HYPOCRELLA.

DOUBTFUL GENERA

Glaziella. Fruit unknown.

23. HYPOCREA Fries, Syst. Orbis Veg. 104. 1825

Stroma subglobose to patellate, fleshy or subfleshy, usually with an abrupt margin which in older specimens is more or less free, or irregular in outline and effused without definite margin; perithecia entirely immersed, subglobose or ovate with the necks slightly protruding; asci cylindrical originally with 8 spores, each of which separates into 2 subglobose or slightly cuboid cells, at maturity 16-spored; spores subglobose or cuboid, hyaline.

Type species: *Sphaeria rufa* Pers.

Distinguished by the 16-spored asci and hyaline spores. There is so little variation in the spores of the species of this genus that we must depend almost entirely upon gross characters for diagnoses of species.

Stromata patellate, with definite outline, for the most part on wood and bark.
Stromata dark colored, dark red, brown or purplish-black.
Stromata red or brown.
Stromata reddish-brown or dark brown. 1. *H. rufa.*
Stromata wine-colored or dark red. 2. *H. scutellaeformis.*
Stromata purplish-black or olive.
Stromata purplish, large, .5–1 cm. in diameter. 3. *H. lenta.*

Stromata olivaceous, small, 1–2 mm. in diameter.	4. *H. minima.*
Stromata bright colored, whitish or bright yellow.	
Stromata whitish.	5. *H. chionea.*
Stromata bright yellow.	6. *H. patella.*
Stromata effused, spreading irregularly, with no definite outline.	
Occurring on wood and bark.	
Stromata very dark olivaceous.	7. *H. olivacea.*
Stromata bright lemon-yellow.	8. *H. sulphurea.*
Occurring on fungi.	
Stroma bright colored.	
Stroma orange, on *Tyromyces.*	9. *H. aurantiaca.*
Stroma lemon-yellow, often fading.	10. *H. citrina.*
Stroma dull pallid or whitish.	
On *Tyromyces* and related plants.	11. *H. pallida.*
Forming rings on cups of *Cyathus.*	12. *H. latizonata.*

1. HYPOCREA RUFA (Pers.) Fries, Summa Veg. Scand. 383. 1849

Sphaeria rufa Pers. Obs. Myc. 1: 20. 1796.

Stromata gregarious, subhemispherical to patellate, occasionally confluent and more or less irregular but normally quite regular in form, 2 mm. to 1 cm. in diameter (mostly 2–5 mm.), externally brick-red, the margin in young specimens white, later becoming brown and in old specimens often free, becoming darker with age, surface of the stroma roughened by the necks of the perithecia which protrude slightly; perithecia nearly globose, 175–200 mic. in diameter; asci cylindrical, becoming 16-spored, 75–100 × 5 mic. (spore-bearing part 60–75 mic.); spores nearly globose, hyaline with a central oil-drop (*pl. 20, f. 6–8*).

On wood and bark of various kinds and occasionally on old fungi.

TYPE LOCALITY: Europe.

DISTRIBUTION: Maine to N. Dakota and S. Carolina. Probably occurs throughout N. America.

ILLUSTRATIONS: Winter; Rabenh. Krypt. Fl. *pl. 89, f. 1–3;* Lindau, E. & P. Nat. Pfl. *f. 243,* A–D.

EXSICCATI: Ellis, N. Am. Fungi, *157;* Ellis & Everh. N. Am. Fungi, *1552;* Ravenel, Fungi Car. Exsicc. *53.* Other specimens examined: Maine, *Miss. White;* N. Jersey, *Ellis 608;* New York, *Zabriskie;* N. Dakota, *Seaver;* Ohio, *Morgan 936, 940.*

2. HYPOCREA SCUTELLAEFORMIS Berk. & Rav. (nomen nudum); Ellis & Everh. N. Am. Pyrenom. 80. 1892.

Stromata gregarious, patellate or subhemispherical, .5–1 mm. in diameter, with the margin free and slightly undulated, roughened slightly by the protruding necks of the perithecia, externally beautifully wine-colored, becoming darker with age, occasionally blackish, internally white.

On the bark of *Acer rubrum*.

TYPE LOCALITY: Carolina.

DISTRIBUTION: Known only from type locality.

EXSICCATI: Ravenel, Fungi Car. Exsicc. *31*.

The species appears distinct in its color and gross characters. Although the stromata externally seem to indicate the presence of perithecia no asci or spores could be seen.

3. HYPOCREA LENTA (Tode) Berk. & Br. Jour. Linn. Soc. **14**: 112. 1875

Sphaeria lenta Tode, Fungi Meckl. **2**: 30. 1791.
Sphaeria Schweinitzii Fr. Elench. Fung. **2**: 60. 1828.
Sphaeria contorta Schw. Trans. Am. Phil. Soc. II. **4**: 194. 1832.
Sphaeria rigens Fr. Elench. Fung. **2**: 61. 1828.
Hypocrea Schweinitzii Sacc. Syll. Fung. **2**: 522. 1883.
Hypocrea contorta Berk. & Curtis; Berk. Grevillea **4**: 14. 1875.
Hypocrea rigens Sacc. Michelia **1**: 301. 1878.

Stromata gregarious, 2 mm.–1 cm. in diameter, lens-shaped, margin free, often becoming undulated, dark colored externally becoming almost black with a shade of olive-green, white within, fleshy becoming hard when dry; surface roughened by the necks of the slightly protruding perithecia; perithecia subglobose, 150–175 mic. in diameter; asci cylindrical, becoming 16-spored, 60–75 $\times$ 4–5 mic.; spores subglobose with 1 large oil-drop, about 4 mic. in diameter.

On wood and bark of various kinds.

TYPE LOCALITY: Mecklenburg, Germany.

DISTRIBUTION: New Jersey to Ontario, California, and Louisiana.

ILLUSTRATIONS: Tode, Fungi Meckl. *pl. 12, f. 102*.

EXSICCATI: Ravenel, Fungi Am. Exsicc. *642;* Ellis, N. Am. Fungi *156*. Other specimens examined: Kansas, *Swingle, Cra-*

gin; Louisiana, *Langlois;* N. Jersey, *Ellis;* Ontario, Canada, *Harkness;* S. Carolina, *Ravenel.*

4. HYPOCREA MINIMA Sacc. & Ellis, Michelia 2: 570. 1882

Stromata scattered, superficial, patellate or subpatellate, disc orbicular, very dark, almost black, scarcely 1 mm. in diameter; surface roughened by the slightly protruding necks of the perithecia; asci cylindrical, becoming 16-spored, 60–75 × 4 mic.; spores subglobose, hyaline, with 1 large oil-drop, about 4 mic. in diameter.

On bark of *Magnolia.*

TYPE LOCALITY: Newfield, N. Jersey.

DISTRIBUTION: Known only from type locality.

SPECIMENS EXAMINED: N. Jersey, *Ellis* (cotype).

In color the species resembles *H. lenta* but is distinguished by its very small size.

5. HYPOCREA CHIONEA Ellis & Everh. N. Am. Pyrenom. 79. 1892

Stromata gregarious, subhemispherical becoming patellate or subpatellate, fleshy, 1–2 mm. in diameter, white or very light yellowish, surface roughened by the slightly protruding necks of the perithecia; necks of the perithecia darker in color than the surrounding surface of the stroma, giving it a punctate appearance; asci cylindrical, 50–60 × 4 mic., becoming 16-spored; spores subglobose, with 1 central oil-drop, about 4 mic. in diameter.

On decaying wood on the under side of a log to which may be due its white color.

TYPE LOCALITY: Ontario, Canada.

DISTRIBUTION: Known only from type locality.

SPECIMENS EXAMINED: Canada, *Dearness* (type).

6. HYPOCREA PATELLA Cooke & Peck, Ann. Rep. N. Y. State Mus. 29: 57. 1878

Stromata gregarious, patellate and regular is form, consisting of a whitish mycelium with a yellow center, becoming entirely bright yellow, inclined to ochraceous, 1–2 mm. in diameter, margin free, surface punctate with the necks of the perithecia which protrude slightly, somewhat wrinkled when dry; asci cylindrical, 60–75 × 4–5 mic., at first 8-spored, becoming 16-spored by the separation of each original spore into 2 subglobose cells; spores subglobose, hyaline.

On dead wood especially on or surrounding other old sphaeriaceous fungi.

TYPE LOCALITY: Buffalo, N. York.

DISTRIBUTION: New York to Louisiana.

SPECIMENS EXAMINED: New York, *Seaver* (various collections); Louisiana, *Langlois 2181;* West Virginia, *Nuttall 75.*

The description of this species is drawn from material identified by Mr. Peck. The species has been frequently collected by the writer about New York City.

7. HYPOCREA OLIVACEA Cooke & Ellis, Grevillea **6**: 92. 1878

Hypocrea melaleuca Ellis & Everh. Proc. Acad. Nat. Sci. Phil. **1890**: 245. 1891.

Stromata scattered, effused and irregular in form, consisting at first of a patch of thin, white tomentum .5–1 cm. in diameter, becoming fleshy and of an olive shade, gradually becoming darker, at length nearly black and punctate from the slightly protruding necks of the perithecia; asci cylindrical, 65–75 × 3–4 mic. becoming 16-spored; spores hyaline, subglobose, 3 mic. in diameter.

On pine boards, bark of *Sassafras,* and oak chips.

TYPE LOCALITY: N. Jersey.

DISTRIBUTION: Known only from type locality.

ILLUSTRATIONS: Grevillea **6**; *pl. 10, f. 25.*

SPECIMENS EXAMINED: N. Jersey, Ellis *2826* (cotype).

The species forms irregular dark colored patches which on drying break up into a number of smaller parts of variable size and number.

Mr. Ellis seems to have been uncertain as to whether *H. melaleuca* was distinct from *H. olivacea,* the stroma of the former having been described as whitish. When examined during the present season the type of *H. melaleuca* shows the stroma to be decidedly greenish and conforms exactly to *H. olivacea.*

8. HYPOCREA SULPHUREA (Schw.) Sacc. Syll. Fung. **2**: 535. 1883

Sphaeria sulphurea Schw. Trans. Am. Phil. Soc. II. **4**: 193. 1832.

Stroma broadly effused, forming irregular patches often several cm. in diameter, at first consisting of small tufts of white mycelium, the central part soon assuming a lemon-yellow color, at

maturity consisting of a bright lemon-yellow stroma with a pale, whitish margin, color in dried specimens fairly constant, rarely slightly faded; perithecia entirely immersed and appearing as minute glands, slightly darker than the stroma; asci cylindrical, becoming 16-spored by the separation of each original spore into 2 subglobose cells, 80–110 mic. in length; spores about 4×5 mic., subglobose or commonly subcubical from mutual pressure, granular within.

On bark of various kinds of trees and shrubs, *Acer, Alnus, Salix, Tilia,* etc., often on *Exidia glandulosa.*

TYPE LOCALITY: Pennsylvania.

DISTRIBUTION: Connecticut to N. Dakota, Alabama and S. Carolina.

EXSICCATI: Ravenel, Fungi Am. Exsicc. *641*, Fungi Car. Exsicc. *52;* Wilson & Seaver, Ascom. & Lower Fungi, *57.* Other specimens examined: Alabama, *Earle, Underwood;* Canada, *Macoun;* Connecticut, *Thaxter;* Delaware (no name); Florida, *Calkins;* Iowa, *Holway;* Louisiana, *Seymour;* N. Dakota, *Seaver;* N. Jersey, *Ellis;* N. York, *Seaver;* Ohio, *Morgan, Lloyd;* Pennsylvania, *Haines, Everhart & Jefferis,* and *Schweinitz* (type).

This species has been commonly known in this country under the name of *Hypocrea citrina* (Pers.) Fries, to which species it is quite similar. Its habitat on bark often where there is no trace of other fungi, its bright color and very large asci and spores seem to be sufficient characters by which it can be distinguished.

In N. Dakota this species has been collected commonly by the writer on dead branches of basswood but was not found in that locality on dead branches of other trees. In other localities it has been commonly reported on other trees and shrubs. Thaxter reports it as occurring in Connecticut only on branches of alders. The species has also been reported by Montagne in Cuba on the bark of trees.

9. HYPOCREA AURANTIACA Peck, Ann. Rep. N. Y. State Mus. 51^1: 295. 1898

Stroma effused, overspreading and entirely covering the hymenium of the host, cottony but giving rise to a continuous stroma

equal in extent to that of the hymenium of the host, deep orange, paler near the margin, staining the host of a similar color; perithecia orange, thickly scattered or often crowded near the center of the stroma where the color is much darker, partially immersed in the substratum; asci cylindrical, becoming 16-spored by the separation of each original spore into 2 subglobose cells; spores subglobose or subcubical, 3–4 mic. in diameter.

On *Tyromyces chioneus.*

TYPE LOCALITY: New York.

DISTRIBUTION: New York.

SPECIMENS EXAMINED: New York, *Peck* (type).

Distinguished from *H. pallida* Ellis & Everh. only by its orange color.

10. HYPOCREA CITRINA (Pers.) Fries, Summa Veg. Scand. 383. 1849

Sphaeria citrina Pers. Obs. Myc. **1**: 68. 1796.

? *Hypocrea Karsteniana* Niessl.; Rehm, Hedwigia **22**: 53. 1883.

? *Hypocrea fungicola* Karsten; Winter, Rabenh. Krypt. Fl. **1**^{2}: 141. 1887.

Stroma effused, spreading irregularly often for several cm. occasionally interrupted, subfleshy, at first whitish, at length lemon-yellow with the margin cottony and lighter colored, within whitish, whole stroma becoming more or less faded with age often subpallid; perithecia immersed, numerous, ovoid, yellowish; asci cylindrical, 62–75 mic. long, becoming 16-spored by the separation of each original sport into 2 subglobose cells with the lower slightly longer; individual spores 3–4 mic. in diameter.

On soil, old fungi, etc.

TYPE LOCALITY: Europe.

DISTRIBUTION: Connecticut to N. York.

EXSICCATI: Shear, N. York Fungi, *363*. Other specimens examined: Connecticut, *Thaxter,* Wisconsin.

This species seems to be less common in America than in Europe, although through its confusion with the species *H. sulphurea* (Schw.) Sacc. it has been commonly reported. The species was originally described as terrestrial and an attempt has been made to separate the terrestrial form from that occurring on old fungi. It is doubtful if the two are distinct.

11. HYPOCREA PALLIDA Ellis & Everh. Jour. Myc. 2: 65. 1886

Stroma effused, overspreading and entirely covering the hymenium of the host, cottony but giving rise to an even stratum equal in diameter to that of the host, at first pallid or pale yellow or often with a slight tinge of rust-red, paler near the margin; perithecia thickly scattered and partially immersed in the substratum with the ostiola projecting, amber, darker than the substratum; asci cylindrical, 50–75 × 4–5 mic. becoming 16-spored by the separation of each original spore into 2 subglobose cells; spores 3–4 mic. in diameter, subglobose or slightly cubical.

On the hymenium of species of *Tyromyces*.

TYPE LOCALITY: N. Jersey.

DISTRIBUTION: N. Jersey to Canada.

SPECIMENS EXAMINED: Connecticut (no name); N. Jersey, *Ellis* (various collections); Prince Edward's Island, Canada, *Macoun*.

Hypocrea aurantiaca Peck agrees with this species in habitat and general morphological characters but seems to differ in possessing a decidedly orange color. The various specimens examined would seem to indicate that the difference in color is due to a difference in age as some of the present species examined show a trace of rust-red approaching that of *H. aurantiaca*, and one specimen in the Ellis collection is labeled in the handwriting of Mr. Ellis, *H. pallida* var. *aurea*. Field observation is necessary in order to determine whether the two species are identical but for the present they are allowed to stand.

12. HYPOCREA LATIZONATA Peck; Ellis & Everh. N. Am. Pyrenom. 79. 1892

Stroma consisting of a white subiculum which forms a band 5 mm. in diameter, entirely surrounding the outside of the cups of the host; perithecia thickly gregarious, immersed, with the ostiola protruding, darker colored, brownish-black; asci cylindrical, 60–75 mic. long, becoming 16-spored by the separation of each original spore into 2 subglobose cells; individual spores 3–4 mic. in diameter, the lower of each pair slightly longer (*pl. 20, f. 9–10*).

On the outside of the cups of *Cyathus striatus*.

TYPE LOCALITY: Ohio.

DISTRIBUTION: Known only from the type locality.

SPECIMENS EXAMINED: Ohio, *Morgan* (type).

Distinguished by its habitat and the peculiar ring-like formations of the stroma.

DOUBTFUL SPECIES

Hypocrea cervina Berk. & Curtis, Jour. Linn. Soc. **10**: 376. 1869.

"Stromate irregulari plano, margine obtuso libero cervino subtomentoso, intus subconcolori; peritheciis superficialibus, ostiolis quandoque elongatis cylindricis; sporidiis subglobosis octonis."

On dead wood. Sporidia .00014 inch in diameter. Stroma 2 lines across.

Hypocrea laetior Berk. & Curtis; Berk. Jour. Linn. Soc. **10**: 376. 1869.

"Stromate orbiculari sublobato adnato laete cervino; peritheciis immersis, ostiolis prominulis nigris; sporidiis subglobosis 16."

"On dead wood. Sporidia .0002 inch in diameter, sixteen in each ascus. Stroma 1–1.5 line across. Closely allied to the last" (*H. cervina* Berk. & Curtis).

Hypocrea maculaeformis Berk. & Curtis; Berk. Jour. Linn. Soc. **10**: 376. 1869.

"Tenuis, umbrina, irregularis, ostiolis brunneolis notata; peritheciis elongatis immersis."

"On a hard lemon-coloured, fleshy *Polyporus,* which is probably much altered by the parasite. Forming thin map-like spots. Sporidia .0004 inch long."

Hypocrea ochroleuca Berk. & Rav.; Berk. Grevillea 4: 14. 1875.

"Effused, thin, ochro-leucous, seated on a pale mycelium, with a barren border, often cracked when old."

Hypocrea polyporoidea Berk. & Curtis, Grevillea 4: 15. 1875.

"Fawn-coloured; perithecia free, tomentose, with a naked ostiolum seated on a pale crust, here and there elevated, which is thin towards the margin. A very curious species."

On beech, Alabama.

Hypocrea armeniaca Berk. & Curtis, *Hypocrea insignis* Berk. & Curtis, *Hypocrea saccharina* Berk. & Curtis and *Hypocrea parasitans* were described from imperfect material.

EXCLUDED SPECIES

Hypocrea subviridis Berk. & Curtis.
Hypocrea Richardsoni Berk. & Mont.

24. **Chromocrea** gen. nov.

Stromata patellate or subpatellate, whitish, yellowish or reddish to greenish-black, more or less variable in a given species, fleshy; perithecia entirely immersed with necks only slightly prominent; asci cylindrical, becoming 16-spored by the separation of each original spore into 2 subglobose cells; spores colored, greenish or brownish.

Type species: *Sphaeria gelatinosa* Tode.

Distinguished from *Hypocrea* by the colored spores.

Stromata yellowish to greenish-black.	
Stromata sessile, yellowish to green, then greenish-black	1. *C. gelatinosa.*
Stromata substipitate, yellow, not becoming green.	2. *C. substipitata.*
Stromata brick-red, entirely sessile.	3. *C. ceramica.*

1. **Chromocrea gelatinosa** (Tode)

Sphaeria gelatinosa Tode, Fungi Meckl. 2: 48. 1791.
Hypocrea gelatnosa Fries, Summa Veg. Scand. 383. 1849.
? *Hypocrea chlorospora* Berk. & Curtis, Grevillea 4: 14. 1875.
? *Hypocrea chromosperma* Cooke & Peck, Ann. Rep. N. Y. State Mus. 29: 57. 1878.
Hypocrea viridis Peck, Ann. Rep. N. Y. State Mus. 31: 49. 1879.

Stromata patellate or subpatellate, fleshy, soft, becoming contracted and wrinkled when dry, at first bright lemon-yellow or yellowish-white becoming punctate with greenish dots, the necks of the perithecia filled with dark colored spores, the entire stroma becoming darker with age, finally greenish or greenish-black 1–4 mm. in diameter; perithecia entirely immersed with the necks slightly protruding and becoming rather prominent in dried specimens; asci cylindrical, becoming 16-spored by the separation of each original spore into 2 subglobose cells; spores at first green, becoming brown, 5 mic. in diameter (*pl. 20, f. 11–13*).

On decaying wood of various kinds.

TYPE LOCALITY: Mecklenburg, Germany.

DISTRIBUTION: Maine to New Jersey and Iowa.

ILLUSTRATIONS: Tode, Fungi Meckl. *pl. 16, f. 123.*

SPECIMENS EXAMINED: Connecticut, *Thaxter;* Indiana, *Underwood;* Iowa, *Seaver, Holway;* Maine, *Harvey;* New Jersey, *Ellis;* Pennsylvania, *Haines.*

The British specimens referred to this name show the surface of the stroma in old specimens to be greenish-black while the base is of a translucent red. The American specimens are more often of a yellowish color with the surface becoming greenish-black. The color in the species is very variable.

2. **Chromocrea substipitata** sp. nov.

Stromata gregarious or occasionally crowded, seated on a sulphur-yellow subiculum, discoid, fleshy, with the margin elevated from the substratum, young plants substipitate; stem short, about 1 mm. thick and 1–2 mm. high, gradually expanding upwards into the subpatellate stroma; stroma plane to a little concave or convex, dull yellow, slightly punctate with the darker ostiola 1–4 mm. in diameter; asci cylindrical, becoming 16-spored by the separation of each original spore into two subglobose cells; spores becoming smoky-brown, 4×5 mic. in diameter.

On bark.

TYPE LOCALITY: Nicaragua.

DISTRIBUTION: Known only from type locality.

SPECIMENS EXAMINED: Nicaragua, *C. L. Smith* (type).

The specimen described under this name was included in the Ellis collection under the name *Hypocrea cubispora* Ellis & Holw. from which species it differs in several points the chief of which is that the asci in the present species become 16-spored while those in *Hypocrea cubispora* Ellis & Holw. are 8-spored. There are other gross characters which are also sufficient to mark this species as distinct from the one to which it had been referred by Mr. Ellis.

The young specimens resemble very closely *Helotium citrinum* (Hedw.) Fries in form but the color is not so bright.

3. **Chromocrea ceramica** (Ellis & Everh.)

Hypocrea ceramica Ellis & Everh. N. Am. Pyrenom. 85. 1892.

Stromata appearing first as a speck of white tomentum, with a brick-red spot appearing in the center, finally becoming fleshy, rather thick and entirely brick-red without, and white within,

subpatellate, convex, becoming wrinkled when dry, punctate with the necks of the slightly protruding perithecia finally dusted over with the greenish spores; asci cylindrical, becoming 16-spored by the breaking of each original spore into 2 subglobose cells; spores about 4 mic. in diameter, the lower of each pair a little larger than the upper.

On bark of decaying limb of *Juniperus*.

TYPE LOCALITY: Connecticut.

DISTRIBUTION: Known only from type locality.

SPECIMENS EXAMINED: Connecticut, *Thaxter* (type).

The stromata resemble in form and color *Hypocrea rufa* (Pers.) Fries, but the species is distinguished by its colored spores.

25. PODOSTROMA Karsten, Hedwigia **31**: 294. 1892

Podocrea (Sacc.) Lindau, E. & P. Nat. Pfl. 1^1: 364. 1897.

Stromata stipitate, clavate, erect, fleshy, light colored; perithecia immersed in the stroma; asci cylindrical, 16-spored; spores globose or subglobose, hyaline.

Type species: *Podostroma leucopus* Karsten.

The type of the present genus as has been observed by Professor Atkinson is similar in every way to *Podostroma alutacea* (Pers.) Atkinson except that it is reported as occurring on dead insects resembling in this the genus *Cordyceps*. Professor Atkinson is of the opinion that this report may simply indicate an extension of the range of decaying organic matter on which *Podostroma alutacea* may grow and that the two species may be identical.

Stroma clavate, yellow.	1. *P. alutaceum*.
Stroma agariciform, brown.	2. *P. brevipes*.

1. PODOSTROMA ALUTACEUM (Pers.) Atk. Bot. Gaz. **40**: 416. 1905

Sphaeria alutacea Pers. Obs. Myc. **2**: 66. 1797.

Sphaeria clavata Sow. Eng. Fungi, *pl. 159*. 1799.

Cordyceps alutacea Link, Handbk. **4**: 347. 1833.

Hypocrea alutacea Tul. Fung. Carp. **1**: 62 (in note). 1861.

? *Podostroma leucopus* Karsten, Hedwigia **31**: 294. 1892.

Podocrea alutacea Lindau, E. & P. Nat. Pfl. 1^1: 364. 1897.

Hypocrea Lloydii Bresadola; Lloyd, Myc. Notes **1**: 87. 1905.

Stroma vertical, consisting of a sterile stem and fertile, clavate or more or less irregular head; stem stout or slender and of variable length, entire plant averaging 2–4 cm. high above the substratum, length below the substratum variable, pale yellow, whitish or tan-colored, fertile head slightly darker; perithecia entirely immersed in the stroma or with their necks slightly protruding; asci cylindrical or slightly clavate, 50–60 × 4 mic., becoming 16-spored by the separation of each original spore into 2 segments; spores subglobose or cuboid, about 4 × 3 mic. the lower of each pair of segments a little longer (*pl. 20, f. 16*).

On wood, decaying organic materials on the ground and (dead insects?).

TYPE LOCALITY: Europe.

DISTRIBUTION: N. York to W. Virginia and N. Carolina.

ILLUSTRATIONS: Atkinson, Bot. Gaz. **40**: *pl. 14–16;* Berkeley, Outl. Brit. Fungi, *pl. 23, f. 6;* E. & P. Nat. Pfl. *f. 243,* F–H; Lloyd, Myc. Notes **1**: *f. 55;* Sow., Engl. Fungi **2**: *pl. 59;* Tul. Fung. Carp. **3**: *pl. 4, f. 1–6.*

SPECIMENS EXAMINED: New Jersey, *Ellis;* New York *Stevens.*

2. **Podostroma brevipes** (Mont.)

Cordyceps brevipes Mont. Syll. 201. 1856.

? *Hypocrea Petersii* Berk. & Curt. Grevillea **4**: 13. 1875.

Hypocrea brevipes Sacc. Michelia **1**: 304. 1878.

Stroma stipitate or substipitate, 1–2 cm. diameter, convex or often irregularly convolute, brown externally, whitish within, papillate with the necks of the slightly protruding perithecia, often dusted over with a yellowish powder, consisting of the exuded spores; stem .5–1 cm. high and 4–5 mm. thick, rugose, darker than the stroma often blackish, expanding above into the agariciform stroma; perithecia covering the upper surface of the stroma, immersed, with the necks slightly protruding, subglobose; asci cylindrical, 75 × 5 mic. becoming 16-spored by the separation of each original spore into 2 subglobose cells with the lower of each pair longer, 4–5 mic. in diameter.

On old wood.

TYPE LOCALITY: S. America.

DISTRIBUTION: Ohio to (Alabama?).

SPECIMENS EXAMINED: Ohio, *Morgan 28, 33.*

From the description *Hypocrea Petersii* Berk. & Curtis seems scarcely to differ. It is described as follows: "Agariciformis; stipite rugoso; peritheciis periphericis; ascis linearibus; sporidiis globosis."

26. STILBOCREA Pat. Bull. Soc. Myc. France **16**: 186. 1900

Stromata consisting of a fleshy hypocreoid base and several erect stilbum-like outgrowths, fleshy, bright colored; perithecia globose or ovate, immersed or with the necks slightly protruding; asci 8-spored; spores hyaline or subhyaline, 1-septate, smooth or rough.

Type species: *Stilbocrea Dussii* Pat.

Distinguished from *Sphaerostilbe* by the immersed perithecia.

Spores 10–12 × 7 mic.	1. *S. hypocreoides.*
Spores 10.5–12.5 × 4.5–5.5 mic.	2. *S. intermedia.*

1. **Stilbocrea hypocreoides** (Kalch. & Cooke)

Sphaerostilbe hypocreoides Kalch. & Cooke, Grevillea **9**: 26. 1880.

Stroma subpatellate or effused, 2–5 mm. in diameter with stilbum-like outgrowths; conidiophores clavate, shortly stipitate; conidia elliptical, 5 × 2 mic.; perithecia immersed in the stroma or with the necks slightly prominent; asci cylindrical, 8-spored; spores elliptical, 1-septate, hyaline, 10–12 × 7 mic., becoming slightly roughened externally.

On naked bark.

TYPE LOCALITY: S. Africa.

DISTRIBUTION: Louisiana.

ILLUSTRATIONS: Grevillea **9**: *pl. 136, f. 25.*

SPECIMENS EXAMINED: Louisiana, *Langlois.*

In the specimens examined it is difficult to find mature asci and spores so that the measurements given above are from the original description.

2. **Stilbocrea intermedia** (Ferd. & Winge)

? *Stilbocrea Dussii* Pat. Bull. Soc. Myc. France **16**: 186. 1900.

Sphaerostilbe intermedia Ferd. & Winge, Bot. Tidssk. **29**: 12. 1908.

Stroma fleshy, patellate or subpatellate, adnate to the sub-

stratum or with the margin free and with several stilbum-like outgrowths consisting of a stalk 1 mm. high and a subglobose head 400–600 mic. in diameter, when dry pale flesh-colored or yellowish-white; perithecia immersed but prominent, orange, ovoid or subglobose, 170–200 mic. in diameter; asci cylindrical, 70–85 × 5.5–7.5 mic., 8-spored; spores 1-seriate, elliptical, slightly unequal-sided, minutely roughened, 1-septate, scarcely constricted at the septum, 10.5–12.5 × 4.5–5.5 mic. (*pl. 20, f. 19–20*).

On bark of trees.

TYPE LOCALITY: Island of St. Thomas, W. Indies.

DISTRIBUTION: Known only from type locality.

ILLUSTRATIONS: Ferd. & Winge, Bot. Tidssk. 29: *pl. 1, f. 5.*

SPECIMENS EXAMINED: Raukiær, Island of St. Thomas (cotype).

This and the preceding species appear to be very close together. No specimen of *Stilbocrea Dussii* Pat. has been seen but there seems to be nothing in the description of the present species to distinguish it from the former in which the spores are described as 12 × 5 mic.

27. **Chromocreopsis** gen. nov.

Stromata gregarious or scattered, tubercular and prominent or depressed, from 2 mm. to 1 cm. in diameter, bright colored or dark approaching black, fleshy or subfleshy, surface slightly roughened and dotted with the slightly protruding necks of the perithecia filled with dark colored spores; asci cylindrical to clavate, 8-spored; spores elliptical to subcuboid, simple or septation indistinct, colored brownish.

TYPE SPECIES: *Hypocrea cubispora* Ellis & Holw.

Distinguished from *Chromocrea* by the 8-spored asci.

Stromata tubercular, large, bright colored, yellow.	1. *C. cubispora.*
Stromata depressed, dark colored, brown or blackish.	
Stromata clothed below with hairs.	2. *C. hirsuta.*
Stromata naked, blackish.	3. *C. bicolor.*

1. **Chromocreopsis cubispora** (Ellis & Holw.)

Hypocrea cubispora Ellis & Holw. Jour. Myc. 1: 4. 1885.

Stromata scattered, tubercular, margin free, more or less contracted at the base often becoming substipitate, .5–1 cm. in diameter and the same in height, at first very bright lemon-

yellow and appearing pruinose, color often changing in dried specimens, surface scarcely wrinkled when dry, punctate with the slightly protruding necks of the perithecia filled with dark colored spores; asci cylindrical, 8-spored; spores subelliptical or cubical, smoky-brown, with 1–2 oil-drops, 5–7 × 4–5 mic. simple or occasionally obscurely 1-septate (*pl. 20, f. 14–15*).

On decaying wood and bark.

TYPE LOCALITY: Iowa.

DISTRIBUTION: Iowa and Jamaica.

SPECIMENS EXAMINED: Iowa, *Holway* (type); Jamaica, *Murrill 636, 736.*

2. **Chromocreopsis hirsuta** (Ellis & Everh.)

Hypocrea hirsuta Ellis & Everh.; Smith, Bull. Lab. Nat. Hist. St. Univ. Iowa 2: 397. 1893.

Stromata gregarious or crowded, subhemispherical, coriaceous-carnose, 2–3 mm. in diameter, discoid, obsoletely margined, brown, yellowish-white inside, contracted below, centrally attached, clothed with brown, bristle-like, septate hairs 100–200 × 4 mic., convex or plane above and slightly roughened by the necks of the perithecia; perithecia buried in the stroma, ovate, about 5 mm. high; asci clavate-cylindrical, swollen at the tip, 100 × 10 mic.; spores navicular-oblong or unequally elliptical, brown, 7–8 × 3–3.5 mic.

On bark.

TYPE LOCALITY: Central America.

DISTRIBUTION: Known only from type locality.

SPECIMENS EXAMINED: Nicaragua, *B. Shimek 80.*

3. **Chromocreopsis bicolor** (Ellis & Everh.)

Hypocrea bicolor Ellis & Everh. Jour. Myc. 4: 58. 1888.

Stromata gregarious or closely crowded, subpatellate or irregular from mutual pressure, slightly convex, 1–3 mm. in diameter, cinereous, becoming dull brownish-black, white within, margin free, upper surface wrinkled when dry and punctate with the necks of the perithecia; perithecia subglobose, about .5 mm. in diameter; asci cylindrical, 70 × 5 mic., 8-spored; spores 1-seriate, elliptical, with 2 oil-drops, smoky-brown, 5 × 2–3 mic.

On decaying wood.

TYPE LOCALITY: Manhattan, Kansas.

DISTRIBUTION: Kansas and Missouri to Louisiana and Central America.

SPECIMENS EXAMINED: Kansas, *Kellerman & Swingle* (type); Louisiana, *Langlois;* Missouri (no name); Nicaragua, Central America, *Shimek.*

DOUBTFUL SPECIES

Hypocrea aurantio-cervina Ellis & Everh. Bull. Torrey Club **24**: 458. 1897.

This appears to be a *Hypoxylon.*

Hypocrea-viridi-rufa Berk. & Rav.; Berk. Grevillea **4**: 14. 1875.

A note from Kew indicates that this is probably a *Hypoxylon.*

28. BYSSONECTRIA Karst. Medd. Soc. Fauna Fl. Fenn. **6**: 6. 1881

Perithecia seated in a scant, cottony stroma, subglobose or ovoid, vertically collapsing; asci cylindrical, 8-spored; spores 1-seriate, often overlapping, elliptical, simple or occasionally pseudoseptate.

TYPE SPECIES: *Byssonectria abducens* Karst.

This genus is intermediate between *Nectria* and *Hypomyces.* The perithecia and spores are very similar to those of *Nectria* while the trace of a cottony stroma suggests *Hypomyces.*

Stroma white; perithecia violaceous.	1. *B. violacea.*
Stroma yellow; perithecia yellowish-brown.	2. *B. chrysocoma.*

1. **Byssonectria violacea** (Schmidt)

Sphaeria violacea Schmidt; Fries, Syst. Myc. **2**: 441. 1822.

Hypomyces violaceus (Schmidt) Tul. Ann. Sci. Nat. IV. **13**: 14. 1860.

Stroma consisting of a thin, white mycelial growth overspreading the substratum; perithecia thickly scattered, globose or subglobose, smooth or only minutely roughened, vertically collapsing, violaceous; asci cylindrical, 8-spored; spores 1-seriate or with the ends slightly overlapping, elliptical, simple, granular within, $6–7 \times 2–3$ mic.

On *Fuligo septica.*

TYPE LOCALITY: Europe.

DISTRIBUTION: Maine.

SPECIMENS EXAMINED: Maine, *Harvey.*

The material here referred to this name corresponds well with the description of the species named above except that the spores are not septate, although they sometimes have a pseudo-septate appearance.

2. BYSSONECTRIA CHRYSOCOMA Cooke & Hark. Grevillea **12**: 101. 1884

Stroma effused, byssoid, golden-yellow; perithecia minute, gregarious, obovate, yellowish-brown, partially immersed in the stroma; asci clavate, 8-spored; spores 2-seriate, narrowly elliptical, simple or doubtfully septate, 10–13 × 3 mic.

On wood of *Eucalyptus*.

TYPE LOCALITY: California.

DISTRIBUTION: Known only from type locality.

No specimen of this species has been seen, however in notes sent from Kew the spore measurements are given and the species seems to have good characters.

DOUBTFUL SPECIES

Byssonectria rosella Cooke & Hark.; Cooke, Grevillea **12**: 101. 1884. Described from imperfect material.

Byssonectria fimeti (Cooke) Sacc. Syll Fung. **2**: 457. 1883. The species was described from material collected by Ravenel. This material has been examined by the writer and the only ascomycete found was a discomycete. Whether this was mistaken for a *Nectria* it is difficult to state.

Hypomyces exiguus Pat. Bull. Soc. Myc. France **18**: 180. 1902.

Stroma byssoid, white; perithecia globose, extruded, scattered, small, 130–160 mic. in diameter, white or slightly yellowish; asci numerous, without paraphyses, cylindrical, 30–35 × 3–4 mic., 8-spored; spores 1-seriate, hyaline, ovoid, smooth, simple, small, 3–4 × 2 mic.

On the fructification of *Stemonitis*.

According to the author of the species this is closely related to *H. violaceus* (Schmidt) Tul. No specimen has been seen.

29. PECKIELLA Sacc. Syll. Fung. **9**: 944. 1891

Peckiella Sacc. (as subgenus) Syll. Fung. **2**: 472. 1883.

Stroma consisting of an effused cottony subiculum, usually parasitic on other fungi; perithecia immersed or partially im-

mersed in the subiculum; asci cylindrical or clavate, 8-spored; spores fusiform, simple, smooth or externally roughened.

Type species: *Sphaeria viridis* Albert. & Schw.

Distinguished from *Hypomyces* by the simple spores.

Stroma dirty greenish. — 1. *P. viridis.*
Stroma not greenish.
  Spores comparatively small, 15–20 mic. long.
    Stroma lemon-yellow. — 2. *P. camphorati.*
    Stroma white, becoming pallid or latericeous. — 3. *P. lateritia.*
  Spores comparatively large, 30 mic. or more long.
    Spores broad fusiform, rough, apiculate.
      Stroma dull orange; on *Cantharellus.* — 4. *P. transformans.*
      Stroma pallid. — 5. *P. Banningiae.*
    Spores narrow fusiform, smooth, non-apiculate. — 6. *P. hymenii.*

1. PECKIELLA VIRIDIS (Albert. & Schw.) Sacc. Syll. Fung. **9**: 944. 1891

Sphaeria viridis Albert. & Schw. Conspect. Fung. 8. 1805.

Hypomyces viridis Berk. & Broome, Ann. Mag. Nat. Hist. **15**: 22. 1865.

Stroma effused, covering the hymenium and stem of the host, dirty greenish or greenish-black; perithecia thickly gregarious and immersed or partially immersed in the subiculum; asci cylindrical or slightly clavate, 8-spored, 175–180 × 5–6 mic.; spores 1-seriate or partially 2-seriate above, fusiform with a long apiculus at each end, 25–35 × 5 mic. becoming delicately verrucose, simple but occasionally appearing obscurely and irregularly septate (*pl. 21, f. 1*).

On the hymenium and stem of agarics, *Lactaria* and *Russula.*

TYPE LOCALITY: Europe.

DISTRIBUTION: New England to N. Carolina.

ILLUSTRATIONS: Albert. & Schw. Conspect. Fung. *pl. 6, f. 8;* Phill. & Plow. Grevillea **8**: *pl. 130, f. 1;* Plow. Grevillea **11**: *pl. 152, f. 2.*

SPECIMENS EXAMINED: Pennsylvania, *Everhart;* (Vermont?), *Burlingham.*

The species is distinguished externally by its dark greenish color and internally by the very large, rough, simple spores.

2. **Peckiella camphorati** (Peck)

Hypomyces camphorati Peck, Bull. N. Y. State Mus. **105**: 23. 1906.

Stroma consisting of a thin effused subiculum overspreading the hymenium of the host and obliterating the gills, forming an even layer, bright lemon-yellow sometimes slightly fading; perithecia numerous, small, immersed in the subiculum or with the ostiola slightly protruding, darker than the subiculum, pale brownish; asci cylindrical, 8-spored; spores 1-seriate, fusiform with a short apiculus at each end, occasionally blunt at both ends, smooth or very minutely rough, 15–20 × 4 mic., simple oozing out and forming a white powder over the surface of the stroma (*pl. 21, f. 6*).

On the hymenium of *Lactaria camphorata.*

TYPE LOCALITY: New York.

DISTRIBUTION: New York.

SPECIMENS EXAMINED: New York, *Peck* (type), *Murrill 2678.*

The spores of this species are similar in size and general appearance to those of *Peckiella lateritia* but the species is easily distinguished by its bright lemon-yellow stroma.

3. PECKIELLA LATERITIA (Fries) Maire, Ann. Myc. **4**: 331. 1906

Sphaeria lateritia Fries; Kunze, Myc. Heft. **2**: 42. 1823.

Hypomyces lateritius Tul. Ann. Sci. Nat. IV. **13**: 11. 1860.

Hypocrea lateritia Fries, Summa Veg. Scand. 383. 1849.

Hypomyces Vuilleminianus Maire, Bull. Herb. Boissier **7**: 138. 1899.

Hypomyces volemi Peck, Bull. Torrey Club **27**: 20. 1900.

Peckiella Vuilleminiana Sacc. & Sydow, Syll. Fung. **16**: 560. 1902.

Peckiella hymenioides Peck, Bull. Torrey Club **34**: 102. 1907.

Stroma effused, more or less cottony, forming an even layer on the hymenium and more rarely on the stem of the host, entirely obliterating the gills, at first white becoming pale yellow or yellowish-brown; perithecia thickly scattered, immersed or with the necks of the ostiola more or less prominent, darker than the subiculum, yellowish or brownish, ovate; asci cylindrical, 8-spored, of variable length often attaining a length of 200 mic.; spores fusiform, usually with a distinct apiculus at each end, unequal sided, at first smooth, becoming delicately verrucose,

hyaline or subhyaline, granular within, nucleate or pseudoseptate, $15-25 \times 4-5$ mic. (mostly $15-20 \times 4-5$ mic.) (*pl. 21, f. 5*).

On different species of gill fungi, especially *Lactariae.*

TYPE LOCALITY: Europe.

DISTRIBUTION: Vermont to Alabama.

ILLUSTRATIONS: Tul. Fung. Carp. **2**: *pl. 30, f. 5.*

SPECIMENS EXAMINED: Alabama, *Earle;* Connecticut, *Earle, Thaxter;* N. Jersey, *Ellis;* Pennsylvania, *Everhart;* Vermont, *Burlingham.*

While this species is usually described as having 1-septate spores, there seems to be much difference of opinion on this point. Maire* states that he had described *Hypomyces Vuillemininianus* believing it to differ from *Hypomyces lateritius* in the absence of the septum of the spores. Having later collected the species commonly and finding the spores to be always non-septate, he began to suspect that the description of *Hypomyces lateritius* by Tulasne† was incorrect. This suspicion was later confirmed by the examination of the original specimen sent from the Museum of Paris. He therefore reunites *Hypomyces Vuilleminianus* Maire and *Hypomyces lateritius* (Fries) Tulasne and states that the spores are verrucose and non-septate. The difference of opinion as to the presence of the septum in the spores of this species seems to be due to the fact that the spore contents often separates toward either end giving a septate appearance.

Hypomyces volemi was described by Dr. Peck on *Lactaria volema* and the spores indicated as fusiform, $12-15 \times 4$ mic., and commonly 2-nucleate. I have examined the type of this species and can discover no character on which to separate it.

Peckiella hymenioides was described by the same author on *Lactaria uvida* and the spores described as simple, subfusiform, pointed or acute at each end, $12-15 \times 4-5$ mic. Cotype material of this species in good condition has been studied and I find that it conforms in every detail with European material which has been distributed under the name of *Hypomyces lateritius* (Fries) Tul.

Since making the above notes I have been permitted to examine

* Ann. Myc. 4: 331. 1906.

† Fung. Carp. 3: 63. 1865.

a specimen of *Sphaeria lateritia* Fries from the herbarium of Fries and this examination has confirmed the observations of Maire that the spores of this species are simple.

4. PECKIELLA TRANSFORMANS (Peck) Sacc. Syll. Fung. 9: 945. 1891

? *Hypomyces insignis* Berk. & Curtis; Berk. Jour. Linn. Soc. 9: 424. 1867.

Hypomyces transformans Peck, Ann. Rep. N. Y. State Mus. 29: 57. 1878.

Subiculum effused, variable in color, dull orange, ochraceous or brick-red; perithecia numerous, thickly scattered, subglobose, partially buried in the subiculum, with a prominent ostiolum, amber or orange; asci cylindrical, 8-spored; spores fusiform with an apiculus at each end, becoming somewhat rough, simple or with the endochrome obscurely divided, hyaline, 32–37 mic. long (*pl. 21, f. 4*).

On *Cantharellus cibarius,* which it transforms into an irregular mass.

TYPE LOCALITY: Sandlake, N. York.

DISTRIBUTION: New York to Massachusetts and Pennsylvania.

SPECIMENS EXAMINED: New York, *Peck* (cotype); Massachusetts, *Harkness;* Pennsylvania, *Everhart.*

The species quite closely resembles *Hypomyces Lactifluorum* (Schw.) Tul.

5. PECKIELLA BANNINGIAE (Peck) Sacc. Syll. Fung. 9: 945. 1891

Hypomyces Banningii Peck, Bot. Gaz. 4: 139. 1879.

Stroma white, then sordid, transforming the hymenium of the host; perithecia crowded, ovate, with a papilliform ostiolum, pale amber or dull yellow; asci cylindrical, slender, 8-spored; spores 1-seriate, fusiform, hyaline, white in mass, 30–35 × 5–6 mic. becoming delicately roughened externally, with a distinct apiculus at each end, simple (*pl. 21, f. 2*).

On decaying fungi apparently some *Lactaria.*

TYPE LOCALITY: Baltimore, Maryland.

DISTRIBUTION: Known only from type locality.

SPECIMENS EXAMINED: Baltimore, *Miss Banning* (type).

Specimens from Pennsylvania referred to this name by Mr. Ellis are *Peckiella hymenii* Peck.

6. PECKIELLA HYMENII Peck, Bull. N. Y. State Mus. **116**: 28. 1907

Subiculum white, overrunning the hymenium of the host and obliterating the gills, sometimes interrupted, becoming yellowish with age; perithecia minute, ovate, immersed with the ostiola protruding, numerous, pale yellow, becoming darker with age; asci cylindrical, 8-spored; spores 1-seriate with ends overlapping, fusiform but not apiculate, straight or a little curved or double curved, simple, slender, 35–40 × 5 mic., oozing from the perithecia forming minute whitish masses upon them (*pl. 21, f. 4*).

On the hymenium of species of *Lactaria.*

TYPE LOCALITY: New York.

DISTRIBUTION: New York to Pennsylvania.

SPECIMENS EXAMINED: New York, *Peck* (type); Pennsylvania, *Everhart.*

The species is quite distinct in the slender, fusiform, non-apiculate spores.

30. HYPOMYCES (Fries) Tul. Ann. Sci. Nat. IV. **13**: 11. 1860

Hypomyces Fries, Syst. Orbis Veg. 105 (as possible genus). 1825.

Nectria Fries, Syst. Orbis Veg. 105 (as possible genus) in part. 1825.

Clintoniella (Sacc.) Rehm, Hedwigia **39**: 223. 1900.

Stroma consisting of an effused, cottony subiculum often of considerable extent (rarely subpatellate and subfleshy), occurring as a parasite on fleshy fungi or more rarely on old wood, rotten leaf mould and other substrata where there is no trace of other fungi; conidial phase variable, represented by species of *Sepedonium, Verticillium* (*Asterophora?*), etc.; perithecia numerous usually thickly scattered and immersed in the subiculum, rarely subsuperficial or with the necks more or less protruding; asci cylindrical, 8-spored; spores fusoid or fusiform, usually with an apiculus at each end or ends blunt, 1-septate, hyaline, smooth or rough.

TYPE SPECIES: *Sphaeria Lactifluorum* Schw.

Stromata orange, purple or rose-colored.
Some shade of orange, occasionally purple with age.
Entirely covering and transforming the hymenium of *Lactariae;* perithecia entirely immersed. 1. *H. Lactifluorum.*
Forming interrupted patches on wood and fungi of various kinds.
Stromata bright orange, fading with age; perithecia entirely immersed, occurring on wood, decaying leaves, etc. 2. *H. apiculatus.*
Stromata dull orange or rust-colored, cottony; perithecia subsuperficial, on fungi of various kinds. 3. *H. aurantius.*
Stroma delicately rose-colored, on wood, etc. 4. *H. rosellus.*
Stromata bright lemon-yellow, amber or pallid.
Stroma bright lemon-yellow.
Stroma yellow, cottony; perithecia reddish, immersed, on *Boleti.* 5. *H. chrysospermus.*
Stroma and perithecia both lemon-yellow; perithecia subsuperficial. 6. *H. aureo-nitens.*
Stroma dull yellow or pallid.
Spores comparatively small, not over 20 mic. long.
Spores unequally septate, rough. 7. *H. hyalinus.*
Spores equally septate, smooth.
On *Coriolus versicolor;* perithecia amber. 8. *H. polyporinus.*
On wood and fungi of various kinds; spores showing a tendency to separate at the septum.
Spores large, 18–20 mic. long; stroma subpatellate. 9. *H. citrinellus.*
Spores small, 10 mic. long; stroma effused, papery. 10. *H. papyraceus.*
Spores very large, 35 mic. long, rough. 11 *H. macrosporus.*

1. HYPOMYCES LACTIFLUORUM (Schw.) Tul. Ann. Sci. Nat. IV. 13: 11. 1860

Sphaeria Lactifluorum Schw. Schr. Nat. Ges. Leipzig 1: 31. 1822.

Hypomyces purpureus Peck, Bull. Torrey Club 25: 327. 1898.

Subiculum thin, effused, covering the hymenium and stem of the host and entirely obliterating the gills, bright orange, color changing to bright purple as the host decays; perithecia thickly scattered, immersed or with the necks slightly protruding, a little darker than the subiculum; asci very long, cylindrical, 8-

spored; spores 1-seriate with the ends overlapping, fusiform with an apiculus at each end, for the most part slightly curved or unequal sided, septate, with the septum in the center, hyaline and strongly roughened at maturity, 35–40 × 7–8 mic., oozing from the perithecia and forming a white powder over the surface of the stroma (*pl. 20, f. 3–5, and pl. 21, f. 7*).

Parasitic on species of *Lactaria*.

TYPE LOCALITY: N. Carolina.

DISTRIBUTION: Maine to N. Dakota and Alabama.

ILLUSTRATIONS: Ellis & Everhart, N. Am. Pyrenom. *pl. 11, f. 12–14;* Bull. N. Y. State Mus. 105: *pl. 103*.

EXSICCATI: Bartholomew; Ellis & Everhart, Fungi Columbiani *1734;* Ellis, N. Am. Fungi *467, 643;* Shear, N. Y. Fungi *89;* Wilson & Seaver Ascom. and Lower Fungi *34*. Other Specimens Examined: Alabama, *Earle;* Maine, *Murrill, 1854, 2040;* N. York, *Peck* (type of *H. purpureus*); N. Dakota, *Seaver;* N. Jersey, *Ellis;* Ohio, *Kelsey;* Pennsylvania, *Haines, Everhart & Wood;* S. Carolina, *Ravenel, Schweinitz* (type); Tennessee, *Murrill.*

Easily distinguished by its bright orange subiculum which entirely discolors the host. The change of color from orange to purple is a noteworthy feature.

2. **Hypomyces apiculatus** (Peck)

Hypocrea apiculata Peck, Ann. Rep. N. Y. State Mus. **29**: 57. 1878.

? *Hypomyces xylophilus* Peck, Bull. Torrey Club **11**: 28. 1884.

Clintoniella apiculata Sacc. Syll. Fung. **16**: 588. 1902.

Subiculum effused, soft, subfleshy, occurring in irregular patches, at first bright orange with the margin sterile and lighter, color very variable in dried specimens fading to pale orange, dull yellow and finally dirty whitish especially when exposed to the light; perithecia thickly scattered, immersed with the necks protruding, darker than the subiculum; asci cylindrical, 8-spored; spores 1-seriate with the ends overlapping, fusiform with an apiculus at each end, usually a little curved, 1-septate and slightly constricted, hyaline, 25–35 × 7–8 mic. becoming a little rough at maturity (*pl. 21, f. 8*).

On decaying leaves, wood, etc.

TYPE LOCALITY: Catskill Mts., New York.

DISTRIBUTION: New York to Virginia.

SPECIMENS EXAMINED: New York, *Peck* (cotype), *Seaver* (various collections); Virginia, *Murrill, 436, 437, 438, 439.*

The present species was not originally described as a *Hypomyces* since the plants do not occur on other fungi as is usually the case. Dr. Peck (l. c.) states: "The spores of *Hypocrea apiculata* resemble those of this (*Hypomyces transformans*) and other species of *Hypomyces* but the plant is not parasitic on fungi an essential character in the genus *Hypomyces* as at present defined." After examination of specimens collected by the writer and determined by Dr. Peck it was concluded that this species was a typical *Hypomyces* and a note from the same man later sustained me in this conclusion.

The genus *Clintoniella* (Sacc.) Rehm was based on this species and was distinguished from *Hypocrea* by the fusiform spores. The latter genus is therefore not well founded.

A specimen of *Hypomyces xylophilus* Peck, collected in Ohio by Morgan and which is apparently cotype has been studied. This appears to be a faded and rather poor specimen of the above species, which often occurs on wood and rubbish of various kinds.

3. HYPOMYCES AURANTIUS (Pers.) Tul. Ann. Sci. Nat. IV. 13: 12. 1860

Sphaeria aurantia Pers. Ic. et Descr. **2**: 45. 1800.

Nectria aurantia Fries, Summa Veg. Scand. 388. 1849.

? *Diplocladium minor* Bon. Handbk. All. Myk. 98. 1851.

Subiculum effused, at first whitish, becoming orange or rust-colored, often covering an area of 5–8 cm. or in smaller, interrupted patches; perithecia thickly gregarious or crowded, orange, darker than the subiculum; subconical, with the ostiola strongly protruding, occasionally with the subiculum almost wanting in weathered specimens; asci cylindrical, 8-spored, with the spores slightly overlapping; spores fusiform, usually a little curved, with a medial septum and a short apiculus at each end, becoming strongly verrucose at maturity (*pl. 21, f. 9*).

On decaying fungi of various kinds.

TYPE LOCALITY: Europe.

DISTRIBUTION: Connecticut to Colorado and Cuba.

ILLUSTRATIONS: Pers. Ic. et Descr. **2**: *pl. 11, f. 4–5.*

SPECIMENS EXAMINED: Colorado, *Cockerell;* Connecticut, *Thaxter;* Cuba, *Earle* and *Murrill 500;* Iowa, *Seaver;* N. Dakota, *Seaver.*

4. HYPOMYCES ROSELLUS (Albert. & Schw.) Tul. Ann. Sci. Nat. IV. **13**: 12. 1860

? *Sphaeria rosea* Pers. Syn. Fung. 18. 1801.

Sphaeria rosella Albert. & Schw. Conspect. Fung. 35. 1805.

Nectria Albertini Berk. & Broome, Ann. Mag. Nat. Hist. **7**: 14. 1861.

Nectria rosella Fries, Summa Veg. Scand. 388. 1849.

Hypomyces roseus Fuckel, Symb. Myc. 182. 1869.

Conidial phase (species of *Trichothecium* and *Dactylium*) forming an effused subiculum often covering an area of 3–8 cm., cottony, at first whitish becoming rose-colored, lighter near the sterile margin; conidia elliptical, hyaline, becoming 1–3-septate; perithecia thickly scattered, darker than the subiculum, nearly blood-red, partially immersed in the subiculum, with the protruding ostiolum acute or more or less obtuse, often collapsing; asci cylindrical, 8-spored; spores 1-seriate with the ends overlapping in the ascus, with an apiculus at each end, 1-septate, septum medial, hyaline becoming slightly rough at maturity, 20–30 × 5 mic. (*pl. 21, f. 10*).

On fungi, old wood and rubbish probably growing on the remains of decaying fleshy fungi.

TYPE LOCALITY: Germany.

DISTRIBUTION: Delaware to N. Dakota, Florida, Louisiana and the W. Indies.

ILLUSTRATIONS: Albert. & Schw. Conspect. Fung. *pl. 7, f. 3;* Tul. Fung. Carp. **2**: *pl. 30, f. 6–9.*

SPECIMENS EXAMINED: Delaware, *Commons;* Florida, *Martin;* Louisiana, *Langlois 2176;* Minnesota, *Holway;* N. Dakota, *Seaver;* Porto Rico, *Goll.*

The species is very distinct in its rose-colored subiculum and fusiform spores.

5. HYPOMYCES CHRYSOSPERMUS (Bull.) Tul. Ann. Sci. Nat. IV. 13: 16. 1855

Reticularia chrysosperma Bull. Herb. France *pl. 476, f. 4.* 1789.
Mucor chrysospermus Bull. Hist. Champ. 1: 99. 1809.
Uredo mycophila Pers. Obs. Myc. 16. 1796.
Sepedonium chrysospermum Fries, Syst. Myc. 3: 438. 1829.
Hypomyces boletinus Peck, Bull. N. Y. State Mus. 75: 15. 1905.

Conidial phase consisting of a golden or lemon-yellow powdery mass which covers the substratum often for several cm.; conidia globose, golden-yellow, beautifully but delicately echinulate, 15–18 mic. in diameter; perithecia gregarious or thickly crowded, nestling in the yellow subiculum, reddish or reddish-brown; asci cylindrical, 8-spored; spores 1-seriate with the ends overlapping in the ascus, fusiform, mostly curved, and becoming when mature slightly rough, 1-septate, with the septum near one end, dividing the spore into two unequal cells with the short cell toward the base, 12–15 × 4 mic. (*pl. 21, f. 16*).

On species of *Boletus.*

TYPE LOCALITY: France.

DISTRIBUTION: New York to Connecticut and Virginia.

ILLUSTRATIONS: Bull. Herb. France *pl. 476, f. 4;* Tul. Fung. Carp. 3: *pl. 8, f. 1–13.*

SPECIMENS EXAMINED: Connecticut, *Burlingham;* New York, *Peck* (type of *H. boletinus*), *Seaver, Galloway;* Virginia, *Murrill.*

Species very distinct with its bright yellow conidia and dark reddish perithecia. The spores in American forms examined are smaller than usually indicated for European specimens, however, as the spores are quite variable in size and other characters conform well it is likely that the American and European specimens are identical.

6. HYPOMYCES AUREO-NITENS Tul. Fung. Carp. 3: 64. 1865

Stroma effused, thin, bright golden or lemon-yellow overspreading the host often for a distance of 2 cm.; perithecia seated in the stroma, very much exserted or subsuperficial, thickly gregarious, often crowded, darker in color than the subiculum, ovate; asci cylindrical, 8-spored; spores 1-seriate with the ends overlapping, fusiform with the ends sharply pointed, 1-septate, with the septum medial, slightly constricted, 15–18 × 4 mic. (*pl. 21, f. 19*).

On old fungi, *Polyporus, Stereum.*

TYPE LOCALITY: Europe.

DISTRIBUTION: Ohio.

ILLUSTRATIONS: Plowright, Grevillea **11**: *pl. 156.*

SPECIMENS EXAMINED: Ohio, *Morgan 19, 27, 37.* Also specimens from the herbarium of *Plowright.*

The spores are a little larger than indicated for the European specimens but otherwise they conform well.

7. HYPOMYCES HYALINUS (Schw.) Tul. Ann. Sci. Nat. IV. **13**: 11. 1860

Sphaeria hyalina Schw. Schr. Nat. Ges. Leipzig **1**: 30. 1822.

? *Hypomyces Van-Bruntianus* Gerard, Bull. Torrey Club **4**: 64. 1873.

Hypomyces inaequalis Peck, Bull. Torrey Club **25**: 328. 1898.

Peckiella hyalina Sacc. Syll. Fung. **9**: 945. 1891.

Subiculum effused, almost entirely covering the host which is often undeveloped, white, pallid or with a tinge of pink or brownish; perithecia thickly scattered, immersed or partially immersed in the subiculum or with the necks slightly protruding, darker than the subiculum, brownish or reddish-brown; asci cylindrical, 8-spored; spores 1-seriate with the ends overlapping, usually with a minute apiculus above, or occasionally obtuse, gradually tapering below, often slightly constricted and septate near the base, at first smooth, becoming strongly verrucose, septation less distinct in mature spores on account of the wart-like markings on the surface, constriction usually evident, 15–20 × 5–7 mic., hyaline or very faintly yellowish (*pl. 21, f. 12*).

Type on *Russula foetens,* also reported on various other agarics which are usually deformed and not easily determined.

TYPE LOCALITY: N. Carolina.

DISTRIBUTION: N. Carolina to Maine.

SPECIMENS EXAMINED: Maine, *Fox* (type of *H. inaequalis*); Massachusetts, *Sturgis;* N. Carolina, *Schweinitz* (type), *Murrill & House.*

The species is well distinguished by the spore characters. The above description was drawn from the type in the Schweinitz collection at Philadelphia.

In the herbarium of the N. Y. Botanical Garden is a letter

dated Sept. 5, 1893, and addressed to Mr. J. B. Ellis by Dr. W. C. Sturgis which reads as follows: "I enclose a specimen of what I take to be *Hypomyces hyalinus* Schw. on a species of *Agaricus* collected at Manchester, Mass. There would be no doubt about it were it not for the peculiarity in the spores. When mature they seem to be unequally uniseptate as in the genus *Stigmatea*. I thought I could distinguish the septum but it may be merely due to the absence of the warted surface plainly visible on the greater part of the spore surface. I would like your opinion on it."

This peculiarity I had already noticed and described in the spores of the type of *Hypomyces hyalinus* (Schw.) Tul., before finding the above note by Dr. Sturgis. I later compared the spores of the specimen collected by Sturgis with Schweinitz's type and find them identical.

Dr. C. H. Peck later described *Hypomyces inaequalis* and in a note stated: "The species is peculiar in having the septum of the spores near the base as in the spores of *Plowrightia morbosa*. This divides the spore into two unequal parts and suggests the specific name." In the type of this latter species the spores are not quite so strongly verrucose but show a tendency to become rough and there is no doubt of its identity.

The spores of *Hypomyces Van-Bruntianus* Gerard were described as follows: "Spores hyaline, oblong, shortly apiculate at the broad end and obtusish at the other, .0006 × .0002′" (15 × 5 mic.). I have examined a specimen of this species from the herbarium of Gerard but was unable to find spores in good condition for study. The general description of the spores indicate that it is a synonym of the above.

8. HYPOMYCES POLYPORINUS Peck, Bull. Buffalo Soc. Nat. Sci. 1: 71. 1874

Peckiella polyporina Sacc. Syll. Fung. 9: 945. 1891.

Subiculum effused, covering the hymenium of the host, entirely obliterating the pores, whitish or pale yellowish; perithecia numerous, thickly scattered or closely crowded, partially immersed in the subiculum, amber; asci cylindrical, 8-spored; spores 1-seriate with the ends overlapping, fusiform, mostly a little curved, smooth, 1-septate, 15–20 × 4–4.5 mic. (*pl. 21, f. 17*).

On the hymenium of *Coriolus versicolor.*

TYPE LOCALITY: New York.

DISTRIBUTION: N. York to N. Jersey and N. Dakota.

EXSICCATI: Ellis & Everh., N. Am. Fungi *1946;* N. Dakota Fungi *8;* Wilson & Seaver, Ascom. & Lower Fungi *35.* Other specimens examined: Canada, *Macoun;* N. Dakota, *Seaver* (various collections); N. York, *Peck* (type); N. Jersey, *Ellis.*

9. **Hypomyces citrinellus** (Ellis)

Hypocrea citrinella Ellis, Bull. Torrey Club **6**: 108. 1876.

Stromata subpatellate, gregarious or scattered, small, 1–2 mm. in diameter, fleshy or subfleshy, pale lemon-yellow, upper surface punctate with the protruding necks of the perithecia, becoming wrinkled in drying; asci cylindrical, 8-spored; spores 1-seriate, strongly overlapping, fusiform with the ends acute, 1-septate, strongly constricted at the septum, 18–20 × 4 mic., showing a tendency to become disjuncted at the septum, especially when removed from the ascus (*pl. 21, f. 14*).

On dead bark of *Vaccinium.*

TYPE LOCALITY: N. Jersey.

DISTRIBUTION: Known only from type locality.

ILLUSTRATIONS: Ellis & Everh. N. Am. Pyrenom. *pl. 11, f. 4, 5.*

SPECIMENS EXAMINED: N. Jersey, *Ellis* (type).

The stromata of this species are subpatellate and resemble very closely those of some of the common species of *Hypocrea.* This together with the fact that the spores sometimes break apart at the septum doubtless explains the reason for the species having been placed in the genus *Hypocrea* by Mr. Ellis. The spores are exactly those of a *Hypomyces* and since the stromata in this genus vary from cottony to fleshy we can scarcely do otherwise than to include the species with this genus. Mr. Ellis in a later description states:* "In the original description, the true character of the sporidia was overlooked, the specimens first found being rather old and the cells of the sporidia separated." He does not however remove it from the genus in which it was originally placed.

* Ellis & Everh. N. Am. Pyrenom. 87. 1892.

The occasional breaking apart of the two cells of the spores is also shown by another species, *Hypocrea papyracea* Ellis & Holw. but in the latter species the stroma is papery and effused. The tendency of the spores to separate at the septum seems to suggest a *Hypocrea* while the form of the spores is that of a *Hypomyces*, and the stromatic characters of the two species partakes as much of the one genus as the other. To me it seems best to place both species in the genus *Hypomyces* since the form of the spores would suggest a close relationship with the other species of this genus.

10. **Hypomyces papyraceus** (Ellis & Holw.)

Hypocrea papyracea Ellis & Holw. Jour. Myc. **2**: 66. 1886.

Stroma effused, consisting of a thin, membranaceous mycelial growth easily separable from the substratum, of a papery consistency, very pale yellow or whitish, 2–3 cm. in diameter; perithecia very minute, about 150 mic. in diameter, subsuperficial, reddish and appearing like minute specks on the surface of the stroma; asci cylindrical, 8-spored; spores 1-seriate with the ends overlapping, fusiform, 1-septate, strongly constricted at the septum and often disjuncted and the cells easily separating, especially when removed from the ascus, 10 × 2–3 mic. (*pl. 21, f. 15*).

On decaying wood and fungi.

TYPE LOCALITY: Iowa.

DISTRIBUTION: Iowa to Ohio.

SPECIMENS EXAMINED: Iowa, *Holway* (type); Ohio, *Morgan* (two collections).

A specimen received from Mr. Morgan of Ohio before his death as *Hypomyces* sp. nov. conforms well with the type of the above species. The species is well characterized by the paper-like consistence of the stroma as well as by the very small perithecia and the tendency exhibited by the spores to separate at the septum.

Hypomyces macrosporus sp. nov.

Stroma consisting of an effused subiculum entirely covering the hymenium of the host and obliterating the gills, pallid or pale ochraceous (in dried specimens), covered over with a pale yellow powder (spores); perithecia numerous and thickly scattered,

entirely immersed or with the ostiola slightly protruding, darker than the stroma; asci cylindrical, 8-spored; spores 1-seriate, strongly overlapping, fusiform, with an apiculus at each end, 1-septate, not constricted or constriction so slight as to be scarcely noticeable, strongly verrucose, hyaline or very pale yellowish, 35–40 × 8–9 mic.

On some gill fungus.

TYPE LOCALITY: Alabama.

DISTRIBUTION: Known only from type locality.

EPECIMENS EXAMINED: Alabama, *Earle & Baker*.

From various descriptions this was at first thought to be *Hypomyces ochraceus* (Pers.) Tul. A note from Leiden however states that there is no material of *Sphaeria ochracea* Pers. to be found in Persoon's herbarium. This species was originally reported as terrestrial while our specimens are parasitic on gill fungi. In the absence of type material it is impossible to state what Persoon's specimens really were but the descriptions usually represent them as having large, smooth, strongly constricted spores. The spores of the present species conform well in size but differ in being unconstricted and strongly verrucose. This together with its parasitic habits would seem to distinguish our species from Persoon's.

DOUBTFUL SPECIES

Hypomyces sepulcralis Pat. Bull. Soc. Myc. France **18**: 179. 1902.

Stroma crustaceous, irregular, white to pale ochraceous, thin; perithecia subglobose, partially immersed, brown, closely gregarious, ostiola conical, protruding; asci cylindrical, narrow, 120–150 × 5–6 mic., 8-spored; spores 1-seriate, fusoid, hyaline, not appendiculate, smooth or a little rough, 1-septate, and not constricted at the septum, 10–14 × 4–5 mic.

On the ground in a cemetery.

According to the author of the species similar to *H. terrestris* Plow. & Boud.

Hypocrea viridans Berk. & Curtis; Berk. Jour. Linn. Soc. **10**: 376. 1869.

Scarcely a line across, composed of thick cylindrical, branched, gelatinous threads; spores 2-seriate, fusiform, narrow, .00057 inch long.

On leaves of *Gesneria*. No specimen seen.

Hypomyces asterophorus Tul. Fung. Carp. **3**: 55. 1865. Perfect fruit not known from N. America.

Sphaeria boleticola Schw. Trans. Am. Phil. Soc. II. **4**: 210. 1832. No specimen could be found in the Schweinitz collection at Philadelphia.

Hypomyces ochraceus (Pers.) Tul. Ann. Sci. Nat. IV. **13**: 12. The specimens of this species reported from N. America do not conform with the original description. No specimen of the type could be found at Leiden.

Hypomyces apiosporus Cooke, Grevillea **12**: 80. 1884. No specimen at Kew. Description suggests *Hypomyces hyalinus* (Schw.) Tul.

Hypomyces tegillum Berk. & Curtis, Grevillea **4**: 15. 1875. Described from immature material.

31. HYPOCREOPSIS Karsten, Myc. Fenn. **2**: 251. 1873

Dozya Karsten, Myc. Fenn. **2**: 28. 1873 (homonym).

Stroma tubercular, fleshy, effused, lobate or stellate, superficial; perithecia immersed; asci 8-spored; spores elliptical, usually 1-septate, hyaline, cells not separating.

TYPE SPECIES: *Sphaeria riccioidia* Bolton.

Distinguished from *Hypocrea* by the 8-spored asci.

Stroma stellately lobed or branched.	1. *H. lichenoides.*
Stroma not stellately branched or lobed.	
Stroma effused, on *Tremella.*	2. *H. tremellicola.*
Stroma patellate, on dead wood.	3. *H. consimilis.*

1. Hypocreopsis lichenoides (Tode)

Acrospermum lichenoides Tode, Fung. Meckl. **1**: 9. 1790.
Sphaeria riccioidia Bolton, Fungi Halifax **4**: 182. 1791.
Sphaeria parmelioides Mont. Ann. Sci. Nat. II. **6**: 333. 1836.
Hypocrea parmelioides Mont. Syll. 210. 1856.
Hypocrea riccioidea Berk. Outl. Brit. Fungi 383. 1860.
Dozya riccioidea Karst. Myc. Fenn. **2**: 221. 1873.
Hypocreopsis riccioidea Karst. Myc. Fenn. **2**: 251. 1873.
Hypocrea digitata Ellis & Everh. Jour. Myc. **1**: 42. 1885.

Stroma radiating from a common center and consisting of several much-divided branches or lobes which extend entirely

around the substratum; lobes 2–3 mm. in diameter and subcylindrical, closely appressed and covering the substratum for a distance of 5 cm., color yellowish, becoming brown or brownish-black with age, upper surface roughened by the slightly protruding necks of the perithecia; perithecia immersed; asci cylindrical or slightly clavate, 8-spored, 80–90 × 12 mic.; spores elliptical, ends obtuse, a little curved, 1-septate, not constricted, hyaline, 25 × 10 mic. (*pl. 20, f. 1–2*).

On partially decayed branches.

TYPE LOCALITY: Mecklenburg, Germany.

DISTRIBUTION: N. Hampshire.

ILLUSTRATIONS: Bolton, Fungi Halifax 4: *pl. 182;* Ellis & Everh. N. Am. Pyrenom. *pl. 11, f. 1–3;* E. & P. Nat. Pfl. 1^1: *f. 244 A.;* Tode, Fungi Meckl. *pl. 2, f. 15.*

SPECIMENS EXAMINED: N. Hampshire, *Miss Minns.*

The species is very distinct in the finger-like branching of the stroma.

2. **Hypocreopsis tremellicola** (Ellis & Everh.)

Hypocrea tremellicola Ellis & Everh. N. Am. Pyrenom. 85. 1892.

Stroma effused, more or less cottony, covering the host; perithecia numerous, immersed with the ostiola slightly protruding, darker than the subiculum; asci cylindrical, 8-spored, 60–75 mic. long; spores 1-seriate, elliptical, slightly smaller toward the base, hyaline, 1-septate, 7–8 × 3 mic.

On *Tremella albida.*

TYPE LOCALITY: Ohio.

DISTRIBUTION: Known only from type locality.

SPECIMENS EXAMINED: Ohio, *Morgan* (type).

In color and general appearance of the stroma this species resembles *Hypocrea latizonata* Peck but differs in that the asci are 8-spored instead of 16-spored.

3. **Hypocreopsis consimilis** (Ellis)

Hypocrea consimilis Ellis, N. Am. Fungi *158.*

Stroma orbicular or elliptical, convex, 2–3 mm. in diameter, brick-red, wrinkled, fleshy; asci clavate to cylindrical, 60–70 × 3.5–4 mic.; spores 1-seriate, hyaline, 10–12 × 3.5–4 mic.

On dead *Azalea viscosa.*

TYPE LOCALITY: N. Jersey.

DISTRIBUTION: Known only from type locality.

ILLUSTRATIONS: Ellis & Everh. N. Am. Pyrenom. *pl. 11, f. 8–9.*

EXSICCATI: Ellis, N. Am. Fungi *158.*

32. OOMYCES Berk. & Broome, Ann. Mag. Nat. Hist. 7: 185. 1851

Coscinaria Ellis & Everh. Jour. Myc. 2: 88. 1886.

Perithecia few, vertical, contained in a membranaceous sac-like structure; asci cylindrical, 8-spored; spores filiform, continuous, hyaline, as long as the ascus.

TYPE SPECIES: *Sphaeria carneo-alba* Libert.

1. OOMYCES LANGLOISII Ellis & Everh. Jour. Myc. 2: 88. 1886

Coscinaria Langloisii Ellis & Everh. N. Am. Pyrenom. 69. 1892.

Stroma tuberculiform, erumpent, fleshy, .3–.5 mm. in diameter, pale carneus or horn-colored when fresh, becoming nearly black when dry, of a rather close membranaceous texture on the surface, softer within, surrounded by the ruptured epidermis, convex above; perithecia ovate, minute, with thin, transparent walls, 250–300 × 150–200 mic.; asci cylindrical, 150–200 × 5 mic.; spores filiform, as long as the ascus, hyaline, continuous, 1 mic. thick.

On dead stems of *Vigna luteola.*

TYPE LOCALITY: Louisiana.

DISTRIBUTION: Known only from type locality.

ILLUSTRATIONS: Ellis & Everh. N. Am. Pyrenom. *pl. 17, f. 5–9.*

SPECIMENS EXAMINED: Louisiana, *Langlois* (type).

33. BARYA Fuckel, Symb. Myc. 93. 1869

Perithecia fleshy, becoming hard in drying, seated in a loose cottony conidia bearing mycelium; conidia oblong, obscurely 1-septate, obtuse at the ends; asci elongated, lanceolate, tapering above and below, with a globose apex; spores filiform, simple, about as long as the ascus, hyaline.

TYPE SPECIES: *Barya parasitica* Fuckel.

BARYA PARASITICA Fuckel. Symb. Myc. 93. 1869

Perithecia gregarious almost crowded yellowish-white, surrounded at the base with a white mycelial growth giving the

whole cluster which is about 3 or 4 mm. in diameter a decidedly whitish appearance; perithecia ovoid, tapering into a rather long neck, almost flask-shaped, rough, 200 × 325 mic.; asci at first very slender tapering above, with a knob-like structure at the apex, becoming broader as they mature, about 200 × 5–6 mic.; 8-spored; spores filiform, nearly as long as the ascus, simple.

On *Bertia moriforms* on wood and (decaying material?) on the ground.

TYPE LOCALITY: Europe.

DISTRIBUTION: New York.

ILLUSTRATIONS: Fuckel. Symb. Myc. *pl. 4, f. 18;* Peck, Ann. Rep. N. Y. State Mus. 43: *pl. 4, f. 13* to *17;* Winter, Rabenh. Krypt. Fl. 1^2: 84, *f. 1–4.*

SPECIMENS EXAMINED: New York City, *Seaver.*

The above description is from a specimen collected by the author on Sept. 24, 1906, in a swampy place in New York City. The specimen when collected, looked decidedly white to the unaided eye and consisted of a rather dense cluster of perithecia about 3 or 4 mm. in diameter, each perithecium surrounded by a white mycelial growth and the whole cluster growing on some kind of decaying material on the ground. The specimen differs a little from Fuckel's description in that the perithecia are of a dirty yellowish-white instead of yellowish-green and in the habitat. But since it was impossible to determine from the specimen collected, the kind of material on which the plants were growing and as they conform very well in other characters they are referred to this name.

Our specimen is evidently the same as Mr. Peck's variety *cespitosa.** The asci are very long and are characterized by the knob-like structure at the apex. Fuckel describes the knob as being at the base of the ascus but Mr. Peck states that the knob is at the apex as it is also in our specimen. This mistake could easily occur however since when the asci are removed from the perithecia it is difficult to determine which is the apex and which the base. The asci in Fuckel's specimens are described as being 146 by 8 mic. The asci are variable in length but the measurements taken here show them to be as long as 200 mic. but the

* Peck, Ann. Rep. N. Y. State Mus. 43: 79. 1890.

immature asci are very much smaller. The spores are long and very slender and no septa could be distinguished. It is difficult to determine the number of spores when enclosed in the ascus but occasionally an ascus may be found broken with the thread-like spores protruding and in this case they may be easily counted. This species is probably rare.

34. TYPHODIUM Link, Abhandl. Akad. Wissensch. Berl. **1824**: 175. 1826

Epichloe (Fries) Tul. Fung. Carp. **3**: 24. 1865.

Stroma effused, subfleshy, at first pale becoming bright orange, forming rings or sheaths about the stems of grasses; perithecia immersed or with the ostiola protruding; asci cylindrical, 8-spored; spores filiform, many-septate.

TYPE SPECIES: *Sphaeria typhina* Pers.

1. **Typhodium typhinum** (Pers.)

Sphaeria typhina Pers. Ic. et Descr. **1**: 21. 1798.
Sphaeria spiculifera Sow. Engl. Fungi, *pl. 274.* 1803.
Dothidea typhina Fries, Syst. Myc. **2**: 553. 1822.
Stromatosphaeria typhina Greville, Scot. Fl. **4**: *pl. 204.* 1826.
Cordyceps typhina Fries, Summa Veg. Scand. 381. 1849.
Epichloe typhina Tul. Ann. Sci. Nat. IV. **13**: 18. 1860.

Stroma effused, subfleshy, at first pale, becoming bright orange, forming sheaths 2–5 cm. in length, about the stems of various grasses; conidia elliptical, hyaline, 4–5 × 3 mic.; perithecia thickly scattered, partially to entirely immersed, soft, membranaceous, similar in color to the stroma, with a rather prominent ostiolum; asci cylindrical, very long, 8-spored; spores nearly as long as the ascus, in a close fascicle, about 2 mic. in diameter, many-septate (*pl. 20, f. 17–18*).

On living grasses: *Agropyron divergens, Agropyron occidentale, Calamagrostis canadensis, Dactylis glomerata, Elymus virginicus, Hystrix hystrix, Koeleria cristata, Panicularia nervata* and *Stipa* sp.

TYPE LOCALITY: Europe.

DISTRIBUTION: N. York to Washington and Mexico.

ILLUSTRATIONS: Greville, Scot. Crypt. Fl. *pl. 204;* Pers. Ic. et Descr. **1**: *pl. 7, f. 1;* Sow. Engl. Fungi *pl. 274.*

EXSICCATI: Ellis & Everh. N. Am. Fungi *185;* Griffiths, W. Am. Fungi, *19, 185;* Wilson & Seaver, Ascom. & Lower Fungi, *80.* Other specimens examined: Delaware, *Commons;* Florida, *Tracy;* Iowa, *Holway;* Missouri, *Galloway;* N. York, *Clinton;* Mexico, (*Holway?*); Ohio, *Morgan;* S. Dakota, *Griffiths,* Washington, *Piper;* Wisconsin, *Davis.*

The hosts cited above are given on the authority of the collectors as the specimens in most cases are not sufficient for determination of the host. Mr. Peck also reports the species on *Carex* sp.

HYPOCRELLA Sacc. Michelia 1: 322. 1878

Stromata patellate or effused, bright colored, often becoming darker with age, fleshy; perithecia immersed or with the ostiola slightly protruding; asci cylindrical, 8-spored; spores filiform, often many-septate and occasionally separating into segments.

TYPE SPECIES: *Hypocrea discoidea* Berk. & Broome.

Hypocrella Tamoneae Earle sp. nov.

Stromata scattered, hypophyllous, 1–1.5 mm. in diameter, black (at least in aged specimens), suborbicular, crust-like, superficial; perithecia crowded, prominent, finally collapsing, 200–250 mic. in diameter; ostiola perforate, large, somewhat irregular; asci cylindrical, short-stipitate, 80–100 × 7–8 mic.; spores thread-like, very slender, equalling in length the ascus, spirally coiled, about 80 × .75 mic.; paraphyses numerous.

On living leaves of *Tamonea* sp.

TYPE LOCALITY: Porto Rico.

DISTRIBUTION: Known only from type locality.

SPECIMENS EXAMINED: Porto Rico, *Underwood & Griggs* (type).

DOUBTFUL SPECIES

Hypocrella Sloaneae Pat. Duss. Enum. Champ. Guadel & Mart. 80. 1903.

Stromata ochraceous, whitish, hemispherical, 2–5 mm. in diameter, covered with the perithecia; perithecia exserted, ovoid of the same color with the ostiola brownish; asci elongated, 12–15 mic. in diameter; spores filiform, soon breaking into fusoid segments; segments hyaline, 9–12 × 2–3 mic.

On the under surface of leaves of a *Sloanea.*

Hypocrella phyllogena (Mont.) Speg., Duss. Enum. Champ. Guadel. & Mart. 80. 1903.

Pulvinate, hemispherical, base constricted, orange; perithecia peripheral, erect, ovate, ostiola punctiform, bright purple, nestling in a stroma of similar color; spores filiform, breaking into segments.

On leaves of *Myrcia octopleura.*

A specimen of this species from the herbarium of Patouillard is sterile.

EXCLUDED SPECIES

Hypocrella atramentosa (Berk. & Curt.) Sacc.
Hypocrella Hyphoxylon (Peck) Sacc.

DOUBTFUL GENERA

GLAZIELLA Berk. Vidensk. Medd. Nat. For. Kjoben. **1879–80**: 31

"Stroma subglobosum laeticolor; perithecia pallida, gelatina repleta."

TYPE SPECIES: *Glaziella vesiculosa* Berk.

GLAZIELLA AURANTIACA (Berk. & Curt.) Sacc. Syll. Fung. **2**: 582. 1883

Xylaria aurantiaca Berk. & Curtis, Jour. Linn. Soc. **10**: 382. 1868.

"Subglobosa, inflata, aurantiaca, polita, subtus pallidior, ostiolis impressis."

"On the ground in woods without apparent attachment. The specimens are unfortunately not mature, but the species belongs to the same category as *X. compuncta*."

The species is bright orange in color the dried specimens becoming much faded. The structure resembles the thin skin of some fruit and is filled with glands which have been described as perithecia.

A specimen of this species was first referred to the writer by Prof. L. M. Underwood having been collected by him as a fungus. Owing to the absence of fruit it was impossible to determine the species and, in fact, we were not entirely convinced that it was a fungus although sections seemed to show mycelial structure.

In the winter of 1908 other specimens of the same species were collected in Jamaica by Dr. W. A. Murrill. During the winter of 1909 in working over the Hypocreales in the collections of the N. Y. Botanical Garden a specimen was found in the Ellis collection (*Cockerell No. 49*) labeled *Hypomyces albolutens* Ellis & Everh. To this packet was attached a note stating that it was typical *Glaziella aurantiaca* Berk. & Curtis according to Massee. Although somewhat faded in color the specimen is identical with specimens collected in the West Indies by Prof. L. M. Underwood and Dr. W. A. Murrill. This species has also been recently collected in Santo Domingo by Mr. Norman Taylor.

EXPLANATION OF PLATE 20

1–2. *Hypocreopsis lichenoides* (Tode) Seaver. 1, gross characters, natural size; 2, portion of ascus with spores, × 350.

3–5. *Hypomyces Lactifluorum* (Schw.) Tul. 3, a gill fungus infected with the parasite, natural size; 4, section through the stroma showing perithecia, partially diagrammatic; 5, ascus with spores, × 350.

6–8. *Hypocrea rufa* (Pers.) Fries. 6, plants natural size; 7, section through the stroma showing perithecia; 8, ascus with spores, × 350.

9–10. *Hypocrea latizonata* Peck. 9, two plants of *Cyathus striatus* infected with the parasite, natural size; 10, ascus with spores, × 350.

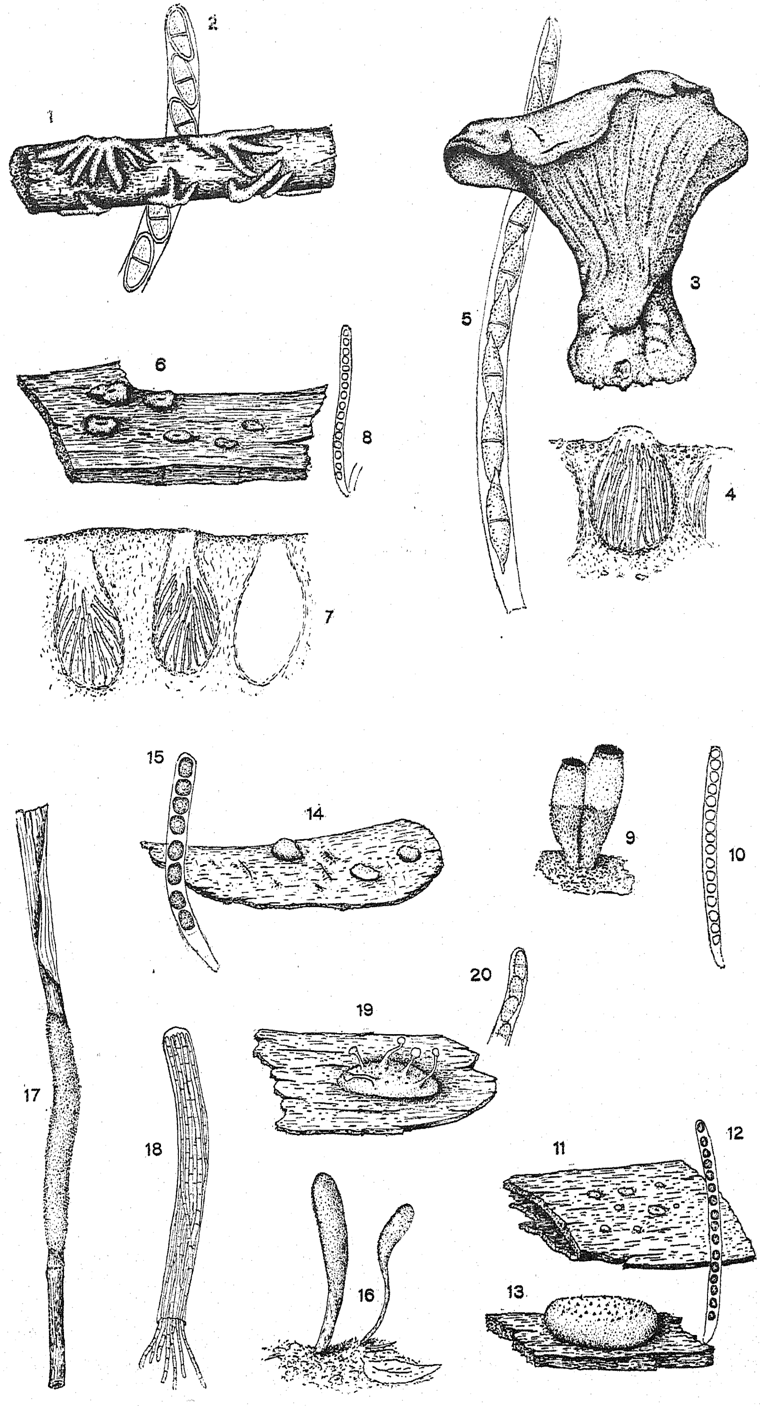
11–13. *Chromocrea gelatinosa* (Tode) Seaver. 11, several plants natural size; 12, ascus with spores, × 350; 13, a single plant enlarged.

14–15. *Chromocreopsis cubispora* (Ellis & Holw.) Seaver. 14, several plants natural size; 15, ascus with spores, × 350.

16. *Podostroma alutaceum* (Pers.) Atk. Two plants natural size.

17–18. *Typhodium typhinum* (Pers.) Seaver. 17, stem of grass infected with the parasite; 18, portion of ascus with spores, × 350.

19–20. *Stilbocrea intermedia* (Ferd. & Winge) Seaver. 19, plant enlarged; 20, portion of ascus with spores, × 350.



HYPOCREAE

EXPLANATION OF PLATE 21

The spores on this plate were drawn with the aid of the camera lucida, the object being to show the comparative size and form of the spores of the different species of *Hypomyces* and *Peckiella*, × 500. The drawings are from type material where such material is available. In a few cases this could not be obtained.

1. *Peckiella viridis* (Albert. & Schw.) Sacc.
2. *Peckiella Banningiae* (Peck) Sacc. Drawn from type material.
3. *Peckiella transformans* (Peck) Sacc. Drawn from cotype.
4. *Peckiella hymenii* Peck. Drawn from type material.
5. *Peckiella lateritia* (Fries) Maire. Drawn from material obtained from the herbarium of Fries and doubtless determined by him.
6. *Peckiella camphorati* (Peck) Seaver. Drawn from type material.
7. *Hypomyces Lactifluorum* (Schw.) Tul. Drawn from type material.
8. *Hypomyces apiculatus* Peck. From fresh material determined by Dr. Peck.
9. *Hypomyces aurantius* (Pers.) Tul. From herbarium material.
10. *Hypomyces rosellus* (Albert. & Schw.) Tul. From herbarium material.
11. *Hypomyces macrosporus* Seaver. From type material.
12. *Hypomyces hyalinus* (Schw.) Tul. Drawn from type material.
13. *Hypomyces aureo-nitens* Tul. Drawn from Ohio material.
14. *Hypomyces citrinellus* (Ellis) Seaver. Drawn from type material.
15. *Hypomyces papyraceus* (Ellis & Holw.) Seaver. From type.
16. *Hypomyces chrysospermus* (Bull.) Tul. From herbarium material.
17. *Hypomyces polyporinus* Peck. Drawn from cotype material.

SPORES OF PECKIELLA AND HYPOMYCES

A NEW FOSSIL POLYPORE

Arthur Hollick

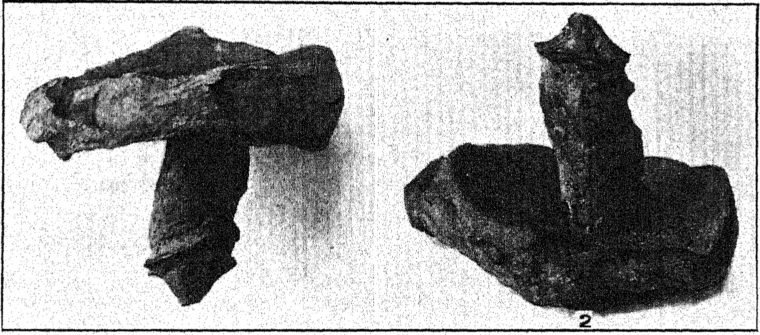
Pseudopolyporus carbonicus gen. et sp. nov.

Pileus about 4.4 cm. in diameter, approximately flat on top with uneven surface, slightly concave beneath with evenly and minutely roughened and pitted surface, margin rather abruptly inflexed. Stalk central or slightly eccentric, cylindical, about 2.8 cm. in length and 1.2 cm. in diameter, with conical base. (*Figs. 1, 2.*)

Carboniferous. Elk Ridge Colliery, West Virginia.

Type in the Museum of the New York Botanical Garden.

This specimen was brought to light during a recent examination of a collection of carboniferous plants from West Virginia, included in the materal deposited with the Garden by Columbia University in 1901. Neither the name of the collector nor the



Figs. 1, 2. *Pseudopolyporus carbonicus.*

date of collection is recorded, the labels merely reading: "Fossil plants below Seam 3, Elk Ridge Colliery, Pocohontas Field, W. Va." This colliery is situated near Ennis, McDowell County, in the southern part of West Virginia.

The fossilizing medium is a highly ferruginous, fine-grained arenaceous shale, which has completely replaced the vegetable

tissue. In fact, the question may be raised whether the specimen is actually of organic origin. The occasional striking similarity of purely inorganic concretions to living organisms, both animal and vegetable, is well known; but in this instance the resemblance to a hymenomycetous fungus appears to be too perfect to be regarded as an accidental simulation.

It is apparently referable to the Polyporaceae, as indicated by the character of the under surface of the pileus, and may be compared with *Polyporus Polyporus* (Retz.) Murrill, so far as its nearest living relationship is concerned; but its antiquity should preclude a reference to the living genus *Polyporus*, and it is clearly different from any of the fossil forms described under that genus or under the fossil genus *Polyporites*, all of which are from the Tertiary or more recent geological horizons, except *Polyporites Bowmanni* Lindley and Hutton,* from the Carboniferous of England, which is generally considered by paleontologists to be a fish scale and not a fungus. In fact, the only fossil forms with which our specimen may be even remotely compared are *Hydnum argillae* Ludwig,† and *Agaricites Wardianus* Meschinelli,‡ both of them from Tertiary horizons.

The generic name is designed to indicate its probable botanical affinities and the specific name its geologic age.

NEW YORK BOTANICAL GARDEN.

* Foss. Fl. Great Britain 1: 183, *pl. 65, f. B1 and B2.* 1831–33.

† "Fossile Pflanzen aus der Altesten Abtheilung der Rheinisch-Wetterauer Teritär-Formation." Palaeontog. 8: 57, *pl. 8, f. 1, 1a–1c.* 1859.

‡ "Di un Probabile Agaricino Miocenico." Atti Soc. Veneto-Trentina Sci. Nat. 12²: 312, *pl. 8.* 1891.

NEWS AND NOTES

Mr. Frank D. Kern, of Purdue University, spent the month of January at the Garden, continuing his studies of the Uredineae of North America.

Dr. M. A. Howe recently returned from an expedition to Panama made primarily for the purpose of collecting marine algae. A number of fungi that inhabit marshy ground and drift-wood were secured on this expedition. The February JOURNAL contains Dr. Howe's report.

A monograph by Dr. C. H. Kauffman of the fifty-six species of *Russula* found in the state of Michigan has recently appeared as a reprint from the eleventh report of the Michigan Academy of Science. It should prove of great value to students of this very difficult genus of gill-fungi.

Several species of Boletaceae have been treated popularly, with illustrations from growing plants, in an article by Mr. W. H. Ballou in the Scientific American Supplement for December 18, 1909.

Mr. Norman Taylor returned from Santo Domingo on January 2, bringing with him 1,700 specimens of plants for the Garden herbarium, among them several specimens of fungi, the perishable species of which were illustrated in colors by Mrs. Taylor. A full account of Mr. Taylor's experiences appeared in the JOURNAL of the Garden for January.

Volume 9, part 3, of North American Flora, containing descriptions of the Boletaceae and Chantereleae by W. A. Murrill, and the genus *Lactaria* by Gertrude S. Burlingham, appeared

February 3, 1910. Several new genera and new species are published in this part.

Professor Bruce Fink, of Oxford, Ohio, has begun a study of the Graphidaceae, and wishes to see as much newly collected material from tropical regions as can be secured. He would be glad to receive such collections for determination or to correspond with collectors in any tropical or subtropical regions.

"Some Problems in the Evolution of the Lower Fungi" (Annales Mycologici 7: 441–472. 1909), by Professor G. F. Atkinson, recently appeared as Publication 43 of the Botanical Society of America, being the address of the retiring president delivered at the Baltimore meeting in 1908. The author advances a number of strong arguments in support of the theory that the lower fungi are derived from unicellular organisms, either colorless or chlorophyll-bearing, rather than from the confervoid or siphonaceous algae.

Dr. W. A. Murrill returned from Mexico January 29 with 2,000 specimens of fleshy and woody fungi, collected at various elevations from the vicinity of Cordoba and Jalapa on the east to Colima and Tecoman on the west. Accompanying the collection are 120 colored illustrations of the more perishable species, drawn by Mrs. Murrill. Many interesting original photographs were also secured. A full account of this expedition will appear in the JOURNAL of the Garden for March.

The gray squirrels in the Hemlock Grove have found the severe winter very trying without their accustomed store of chestnuts. Mr. E. W. Humphreys recently observed one of them making a meal on *Stereum hirsutum,* a leathery fungus occurring commonly on dead wood, which would seem unpalatable to the last degree. During the summer, squirrels are very fond of species of *Russula,* and other fleshy forms appearing on the forest floor, and red squirrels in Alaska have been known to carry fleshy forms into the trees and preserve them for future use; but I believe this is the first instance recorded where a tough form like *Stereum* has been so used.

The danger to buildings from the dry rot fungus (*Merulius lacrymans*) has not been recognized in this country as it has in Europe and builders have been allowed to use unseasoned wood to a large extent. A recent investigation in New York City by Professor I. H. Woolson, of Columbia University, brought to light an astonishing condition of affairs in a great number of wooden buildings, which may collapse as did the Gledhill factory unless speedily repaired.

The first annual meeting of the American Phytopathological Society was recently held in Boston in connection with the meetings of the A. A. A. S. A large number of interesting papers on plant diseases were presented. The following officers were elected for the ensuing year: *President,* F. L. Stevens; *Vice-president,* A. F. Woods; *Secretary-Treasurer,* C. L. Shear, U. S. Department of Agriculture, Washington, D. C.; *Councillors,* L. R. Jones, A. D. Selby, and H. H. Whetzel.

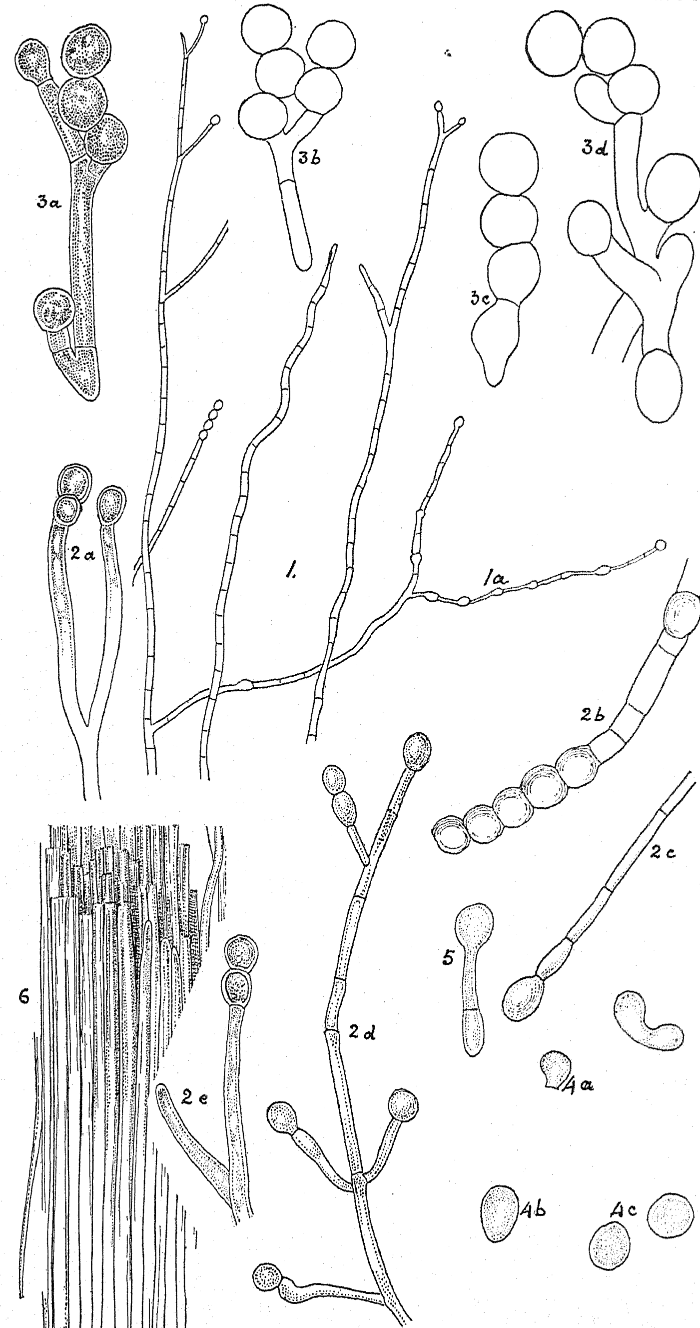
Bulletin 63 of the department of agriculture of the central experimental farm, Ottawa, Canada, reports an outbreak in Newfoundland of the very serious potato disease known as potato canker (*Chrysophlyctis endobiotica* Schilb.). This is the first record of this pest for America, it having been formerly known only in Europe.

The presence of the disease cannot be detected until the tubers are lifted from the ground, and, when present, scarcely a healthy potato can be found. The disease first makes its appearance in the eyes of the potato and is here characterized by an abnormal development of the shoot, giving rise to small nodules of a rusty-brown color. Later, the entire potato is attacked and is often completely decomposed.

This is one of the most serious pests of the potato known and the above bulletin is issued as a warning, especially to the potato growers of Canada. It is requested that any suspicion of the presence of this disease be at once reported to the station, together with specimens of the diseased plants.

The following review of Mr. M. C. Potter's paper, "Uber eine Methode, parasitäre Krankheiten bei Pflanzen zu bekämpfen" (Centralb. f. Bakt. 2 ser. 23: 379–384. 1909), has been kindly contributed by Mr. E. D. Clark:

Pseudomonas destructans is the cause of the so-called "white rot" of the beet. This parasite secretes an enzyme, cytase, which dissolves the cell-walls of the plant, allowing the toxin of the parasite to come into direct contact with the protoplasm of the host, which is thus quickly destroyed. Both the cytase and toxin of *P. destructans* are very powerful, making the organism very virulent. In many cases the products of the life activities are toxic to the growth of a given plant or animal if not removed. This is true in the case of the present organism, for the author found that it produces substances toxic to its further growth, whatever it grows upon. The author's experiments indicate that the toxin thus produced by the growth of the parasite is able to withstand boiling, while the cytase, like most enzymes, is completely destroyed by such treatment. Some of the solutions containing the toxin and cytase were concentrated by vacuum distillation at 60°, which did not alter the toxin, but destroyed the activity of the cytase. In all concentrations, including that of the original culture liquid, the toxin solutions completely stopped further growth of *P. destructans*, both on the beet and in other nutrient media, and, also, as seen under the microscope, all movement was immediately inhibited. The toxin solution is specific in its action only on the parasite producing it, but it also shows a certain destructive effect on the host cells, although the latter soon heal over, since no cytase is present to destroy the cell-walls. Next, the author prepared in the same manner toxin solutions from *Penicillium italicum*, which is the cause of a destructive disease of oranges, lemons, etc. Ths solution showed exactly the same specific inhibiting qualities shown by that of *P. destructans*. From these observations, the author thinks it possible that such toxin solutions obtained in a similar way from growths of bacteria, fungi, etc., might prove to be of great practical importance in combating the ravages of these organisms.



MONASCUS PURPUREUS WENT

MYCOLOGIA

Vol. II   May, 1910   No. 3

MONASCUS PURPUREUS IN SILAGE

R. E. Buchanan

(With Plates 22 and 23, Containing 31 Figures)

During the year 1909, the writer had frequent occasion to examine the molds which are common in silage not properly prepared or cared for. Such moldy silage has in several instances caused the death of farm animals, particularly horses; the symptoms of the disease being those of "forage poisoning" or "equine cerebro-spinal meningitis." Numerous cultures have been made and many molds isolated from different silages, among them several species of *Penicillium, Aspergillus, Mucor,* the mycelium of a hymenomycete (probably a *Coprinus*), and, in one instance, *Monascus.* The last mentioned was practically the only mold found in one sample. Inasmuch as no record has been found of its occurrence in America and no record of its occurrence in silage, a brief account of the fungus is here given with notes on its morphology and cultural characters.

In March, 1909, a moldy sample of silage was brought to the laboratory by a veterinarian. It was part of the contents of a silo and had been the apparent cause of the death of nine horses that had been fed upon it. Experimental evidence was brought forward later by Dean Stange, of the Department of Veterinary Medicine at the Iowa State College, which demonstrated the causal relationship of this silage to the disease. An examination of the material showed it to be thoroughly infected and matted with the mycelium of *Monascus.* Although no experimental evi-

[Mycologia for March, 1910 (2: 43–98), was issued March 8, 1910]

dence of any direct relationship between this particular organism and the death of the horses has been shown, the fungus has been thought worthy of study and record on its own account.

GROSS CHARACTERS OF THE MOLD

It is generally known that silage insufficiently packed or too dry when cut is much more apt to mold than that which is moist and well compacted. The material brought to the laboratory was much drier than usual, and matted together by mold into large masses which offered considerable resistance to being torn apart. Examination showed all parts of the silage, leaves, stalks, and ears, to be covered with a white layer of mold, forming cottony masses in some of the spaces. Where it occurred on the kernels of corn, particularly where they had been broken or crushed and the starchy endosperm exposed, the mold often assumed a pink to carmine-red color.

ISOLATION AND CULTURAL CHARACTERS

Silage agar. Five hundred grams of fresh silage was boiled for thirty minutes in one liter of tap water. This was then filtered and the silage on the filter washed with hot tap water until a liter of the decoction was secured. This was autoclaved with one and one half per cent. agar agar threads, filtered, tubed, and sterilized. Dilutions were prepared from the silage mold at points where conidia were found most abundant. These conidia germinated within twenty-four hours in most instances. The mold colonies in the lower dilutions did not develop very far on account of the luxuriance of bacterial growth. In the other plates, however, the bacterial colonies were scattered so that they did not interfere with the normal development of the mold. The inhibition of mold growth in the presence of large numbers of bacteria is a possible explanation of the fact that moist silage decays without becoming moldy through the activity of bacteria, while silage somewhat drier becomes covered with molds. Within the course of a week these mold colonies were from one half to one and a half centimeters in diameter. The outlines of the colonies are very indefinite, for the organism grows almost entirely within the substratum, forming there conidia and peri-

thecia near the center of the colony. However, aërial hyphae are usually produced, forming a cottony surface growth not more than a millimeter in height. Within a few days, the colony, particularly near the center, becomes tinged with red and in two

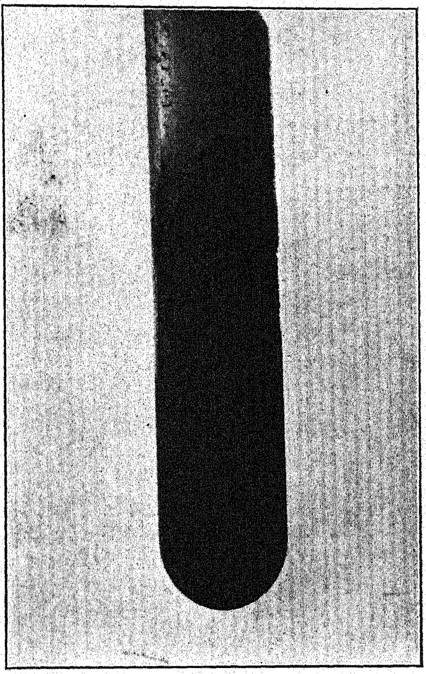


FIG. 1. Colonies of *Monascus purpureus* two weeks old in silage agar.

or three weeks is a deep carmine. This coloring gradually extends throughout the colony, always being deepest near the center.

Silage broth. A decoction of silage was prepared as outlined in the preceding paragraph, and used without further additions in 50 c.c. lots. The organism grows rather slowly in this medium, forming spherical cottony masses of hyphae not easily broken up by shaking. In one to two weeks the hyphae reached the surface of the medium (a distance of about 2 cm.) and two weeks later the surface growth attained a diameter of from 1–4 cm. This surface growth develops large numbers of aërial hyphae, not extending more than one millimeter above the surface. There

is a red pigment produced in some cases, but most cultures remain perfectly white (Fig. 2).

Glycerin solutions. Harz (1890) described *Physomyces heterosporus* from the surface of glycerin vats in a soap factory. Here, as well as in the laboratory, it grew on solutions containing as much as 30 per cent. of glycerin. To determine the ability of

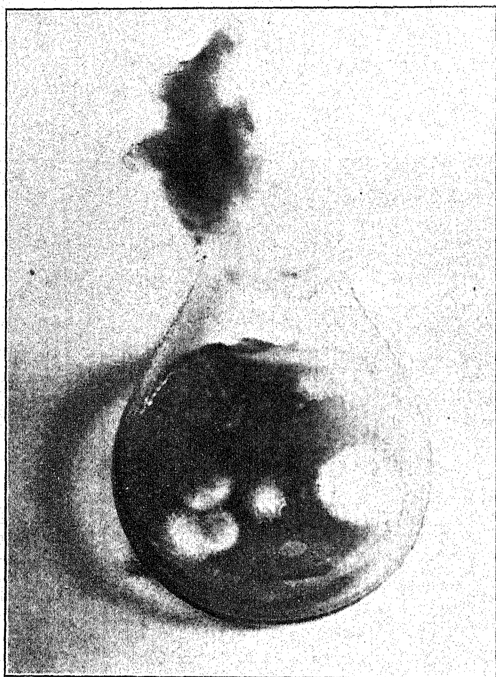


FIG. 2. Colonies of *Monascus purpureus* one month old in silage decoction.

the organism in question to use glycerin, flasks containing 100 c.c. of 5, 10, 20 and 40 per cent. glycerin in tap water were inoculated with pure cultures of *Monascus*. Growth occurred in the 5 and 10 per cent. solutions, but little or none in the 20 and 40 per cent. solutions. In the 5 per cent. solution small masses of mycelium could be observed within a few days, floating in the liquid. These continued to enlarge slowly for two months, at the end of which time they formed a semi-transparent mass of a quarter of the volume of the medium. The interior of such masses was

found to be densely matted, and of a deep carmine color. In a 10 per cent. solution of glycerin growth was slower, the colonies or mycelial balls remaining smaller and more compacted.

Rice flour. A thick paste of rice flour in tap water was prepared and sterilized in test tubes. Growth on this medium was more luxuriant than on any other tried. Within two days after inoculation, mold patches could be observed, as delicate white colonies arising from the surface of a carmine-red medium. The mycelium completely covered the surface within a few days and the medium changed to an orange-red. The surface of a culture a month old is somewhat wrinkled, the fungus forming a gray felt, with the medium itself entirely red.

MORPHOLOGY

The hyphae of the organism vary from 2 to 5 μ in diameter, branching abundantly and rather irregularly. When within the medium or just at its surface, branching is much more abundant than in the aërial hyphae. Under certain conditions, as between broken corn kernels, the hyphae may lie tightly packed side by side (*pl. 22, f. 6*) with little or no branching evident. The mycelium does not produce differentiated vegetative hyphae and conidiophores. The conidia may appear terminal on almost any branch. The hyphae are septate, the cell contents usually granular, and the older cells are vacuolate and contain oil drops.

Barker (1903) has noted the frequent occurrence of swellings on the hyphae of *Monascus,* particularly when the concentration of the solution had increased by evaporation, as in an old hanging drop. That this is not the only cause of such swellings is evident from pl. 22, f. 1, which shows their presence on aërial hyphae. They were also found abundantly in the 5 and 10 per cent. glycerin cultures. In size and shape these swellings approach the conidia. On starchy media, and in some others, the red coloring matter is to be found irregularly distributed through the older threads.

Conidia. The conidia are borne singly or produced in basipetal chains of 2–6 or more. They may be found on aërial hyphae, or imbedded in agar or immersed in a nutrient solution. They may even be abstricted by the tips of the filaments which invest the

perithecium. No evidence of the formation of micro- and macro-conidia could be discovered, although considerable variation in size was noted, from 6 to 10 by 7 to 15 μ. The conidia are sometimes tinged with red in old cultures; usually, however, they are colorless (*pl. 22, f. 2, 3*). Germination occurs under suitable conditions within a few hours (*pl. 22, f. 5*).

Ascocarp or "Perithecium." The fruiting body of *Monascus* (or *Physomyces*) was first described by Harz (1890) as a sporangium or sporocarp. More recent writers, as Barker (1903) and Olive (1905), have shown it to be of an ascomycetous type, although this claim has been denied by Ikeno (1903). All are agreed, however, that it is produced as the result of a true sexual fusion. Observations of the form in question seem to indicate that the interpretation given by Olive (1905) is the correct one. Serial sections have not been prepared, however, and the exact sequence of events cannot be accurately determined without a careful study of the subject. The perithecia develop in great numbers upon the hyphae and are generally terminal, though sometimes apparently lateral (*pl. 23, f. 8*). The young perithecia may be found in suitable media within two or three days after sowing the conidia. They develop not only on aërial hyphae, but also in the body of a medium such as agar, and nowhere were they found more abundant than in 5 and 10 per cent. glycerin solutions. So marked is this ability to produce perithecia and conidia under water, that the organism might well be classed as one of the aquatic molds. An antheridial cell fuses with a functioning egg cell, and, within this, are developed the ascogenous hyphae which ultimately form one to many asci, each typically with eight ascospores. The steps in this process can be seen only with difficulty, for the "central cell" soon becomes closely invested by sterile hyphae which branch and apparently anastomose about it.

Various steps in the development of these hyphae may be seen in the figures (*pl. 23, f. 4–10*). Sometimes branches may extend out from this investing mass (*pl. 23, f. 10*) and even produce conidia. These hyphae soon lose their contents and collapse, forming a thin membrane at maturity, which sometimes shows little evidence of its origin. Pl. 23, f. 11 shows a perithecium

nearly mature, with the ascospores grouped within the asci. The walls of the latter soon disintegrate and the ripe perithecium filled with loose spores resembles the sporangium of a phycomycete. These perithecia vary from 25 to 50 μ in diameter. They are usually terminal at the end of a long hypha, but in some media there may be noted variations in the length of this pedicel. The spores within the perithecium number from 6 or 8 to several hundred. They are nearly spherical in shape and from 3.5 to 6 μ in diameter. They are usually tinged with brown or are slightly fuscous when mature.

SPECIFIC POSITION OF SILAGE MONASCUS

There have been described in literature five species of *Monascus*. *M. heterosporus* Schröter (*Physomyces heterosporus* Harz) differs from the form in question in having two types of conidia, having smaller conidia, and developing in much more concentrated solutions of glycerin. *M. ruber* van Tieghem differs in having larger conidia and spores and a red perithecium. *M. mucoroides* van Tieghem has larger perithecia, spores and conidia. *M. purpureus* Went agrees in all essential characters, and this organism is placed here tentatively. *M. purpureus* is the characteristic mold used by the peoples of eastern Asia in the preparation of "red rice" (Ang-quac). The fact that rice covered with this mold is used by the Chinese as food rather militates against the possibility of the form in silage being poisonous. This has not, as before stated, been investigated as yet, and further study may cause a change of view as to its specific position.

SUMMARY

A mold answering to the description of *M. purpureus* Went was found to be the typical fungus present in a moldy silage which killed eleven horses. The pathogenic properties of the organism have not as yet been wholly determined. This appears to be the first record of the occurrence of *Monascus* in this country.

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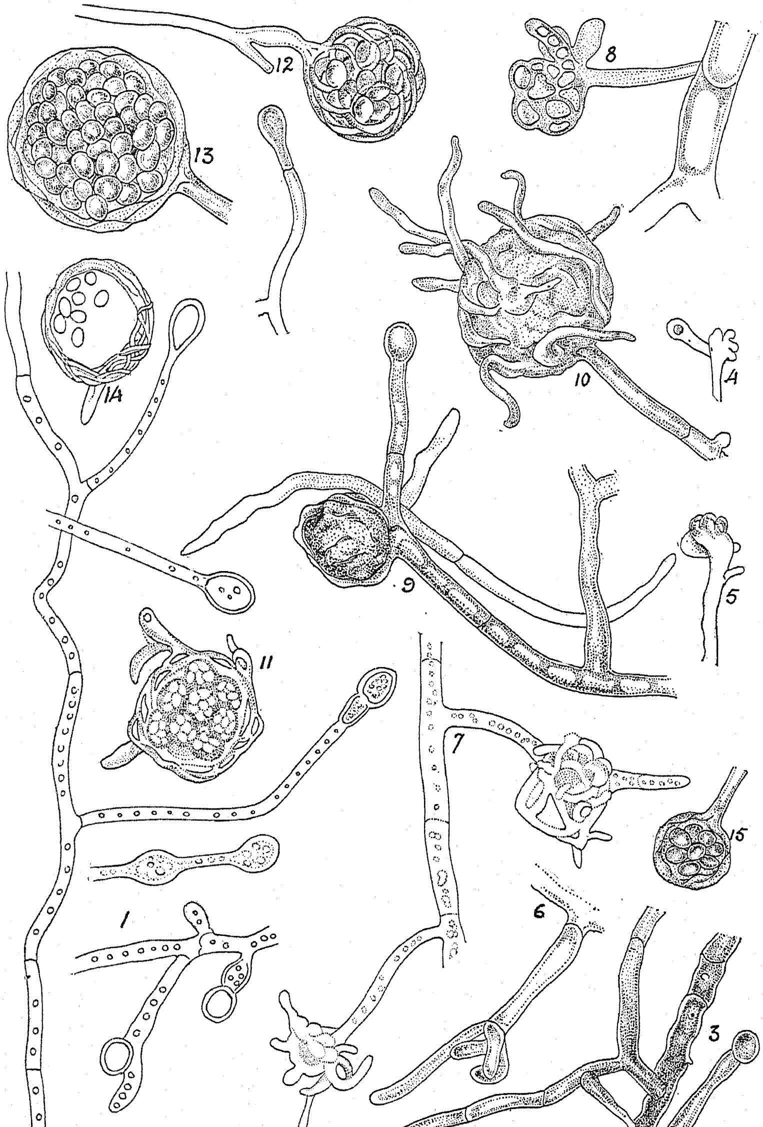
IOWA STATE COLLEGE,
AMES, IOWA.

EXPLANATION OF PLATE 22 (frontispiece)

1. Aërial hyphae with conidia and with swellings at *1a* on a branch.
2a, 2b, 2c. Conidiophores with conidia.
3a, 3b, 3c, 3d. Conidiophores with conidia.
4a, 4b, 4c. Conidia.
5. Conidium germinating.
6. Mass of parallel hyphae from surface of moldy corn kernel.

EXPLANATION OF PLATE 23

1, 2. Hyphae with oil drops and conidia from glycerin solution.
3. Hyphae and conidia from silage decoction.
4, 5, 6. Very early stages in formation of perithecium.
7, 8, 9. Sterile hyphae branching and anastomosing about "central cell."
10. Sterile hyphal covering of perithecium sending out branches. These are sometimes tipped with conidia.
11. Optical section of nearly mature perithecium. Spores still within asci.
12, 13, 14, 15. Optical sections of mature and nearly mature perithecia, showing variations in size.



MONASCUS PURPUREUS WENT

STUDIES IN PYROPHILOUS FUNGI — II.*

CHANGES BROUGHT ABOUT BY THE HEATING OF SOILS AND THEIR RELATION TO THE GROWTH OF PYRONEMA AND OTHER FUNGI

FRED J. SEAVER AND ERNEST D. CLARK

(WITH PLATES 24–26, CONTAINING 6 FIGURES)

(FROM THE LABORATORIES OF THE NEW YORK BOTANICAL GARDEN)

I. INTRODUCTION

Our observations noted in previous papers as to the occurrence of *Pyronema* on burned-over or heated soil had been previously noted by Kasaroff, who in this connection states that this striking phenomenon could not be explained on the assumption that the fungus had survived the heating, a subsequent infection being a much more likely explanation. The results of numerous experiments are not wholly consistent but point to certain conclusions.

Kasaroff thought that the absence of growth on unheated-soil is not due to the fact that through the process of heating more material necessary to the fungus is set free but rather that the unheated-soil contains constituents which render the growth of the fungus impossible, which constituents are destroyed by heat-

* Studies in pyrophilous fungi—I. Occurrence and cultivation of Pyronema, was published in MYCOLOGIA 1: 131–139. 1909.

ing. It was not found possible by washing with water to wholly remove from the unheated-soil the unfavorable constituent but the soil extract contained the substances of unheated-soil which are unfavorable to the growth of *Pyronema*. Experiments with heated-soil showed that the properties favorable to *Pyronema* growth which were developed in the soil by heating may be removed from the soil by washing and in other ways. The reason for this is not clear. By boiling the extract of an unheated-soil its unfavorable properties may be partially removed. An extract of heated-soil cannot, to any great extent, render an unheated-soil a favorable nutrient medium for *Pyronema* but this may be accomplished by the addition of kainite, while the addition of charcoal, coal, and coke in various forms yields no beneficial results.

II. Toxin Theory

The conclusions of Kasaroff as to the reasons for the failure of *Pyronema* to grow on unheated-soil while it thrives on heated-soil seem to indicate that the unheated-soil contains a substance toxic to *Pyronema* which substance is destroyed by heat. This explanation is strengthened by the fact that other investigators have found in soils substances toxic to the higher plants, which substances inhibit the growth of such plants even in the presence of an abundance of food material.

The idea that there are toxic organic materials in soils arising from previous plant growth or otherwise, is rather a new conception but one which has been advanced and confirmed by Schreiner and his collaborators in the last few years. According to these conceptions there are definite, organic compounds in the soil, which, in the case of four substances, have been isolated, crystallized and analyzed, thus proving their composition and constitution. Some of these substances were proved to be harmful to plants by water-culture experiments, and all of them belong to types of substances that may well prove toxic to different kinds of plants on further investigation.

Such organic bodies may arise in a variety of ways, by root excretions from the growing plants, by simple decomposition and oxidation of the plant remains in the soil, and by bacterial action, etc. When one remembers that the plant body contains besides

carbohydrates and proteins, the following more or less complex substances; alkaloids, glucosides, tannins, hydrocarbons, resins, etc., it is not difficult to imagine how compounds toxic to the plant might well arise either directly or through bacterial action, slow oxidation or other deep-seated changes. Schreiner has shown that the growth of a plant in a solution makes that solution rather toxic to the growth of the same plant in the same medium because of the throwing off of toxic organic substances, rather than the depletion of the food supply by the growth of the plant.

All of this shows that in questions of soil fertility for certain plants, we must not only consider what necessary food materials are present but also determine, if possible, whether there are any toxic substances present which would check plant growth even in the presence of an abundant supply of organic and inorganic food materials.

In order to test the toxin theory with reference to the growth of *Pyronema,* an extract of unheated-soil was prepared by adding four liters of distilled water to two kilograms of unheated-soil. This mixture was stirred frequently and allowed to stand for some time and later filtered and used for the treatment of heated-soil.

On November 11, 1909, a series of experiments was conducted in which three pots of soil heated to about 160° C. for about two hours (S^1, S^2, and S^3) were used, with a pot of similar soil unheated as a control (C). Pot (S^1) and control (C) were treated with distilled water. Pot (S^2) was treated with extract of unheated-soil prepared in the above manner, the mixture having been allowed to stand with frequent stirring for two hours. Pot (S^3) was also treated with extract of unheated-soil on the following day, the mixture having been allowed to stand for twenty-four hours instead of two as in the preceding experiment. Each was inoculated with *Pyronema.*

On November 23, (S^1) and (S^2) showed fair growth of *Pyronema* especially on the pots, but at this time no fruit had appeared, while (S^3) showed good growth of mycelium and fruit. Control (C) gave negative results as usual.

Other experiments similar to the above were later conducted. In each case the heated-soil treated with the extract of

unheated-soil prepared in various ways proved to be fully as favorable, as culture media for *Pyronema,* as similar soil treated with distilled water, the variations being no more marked than would be expected in experiments of this nature. Heated-soil treated with distilled water and that treated with the extract of unheated-soil both gave good results.

These results indicate that if the failure of *Pyronema* to grow on unheated-soil is due to toxic constituents present in the soil these substances are not soluble in water, at least not in sufficient quantities to render extracts of such soils toxic to *Pyronema.*

III. Pyronema Growth a Food Problem

It had often been noted in the course of our experiments that heated-soil when watered had a peculiar and characteristic pungent odor, together with the rather pleasant odor of caramel. It had also been noted that heated-soil when watered, often assumed a darker color than the same kind of soil unheated and watered in the same manner. This change of color was not universal but frequently occurred and probably depended upon the intensity of the heat.

Having repeatedly failed to show that the extract of unheated-soil had any toxic influence on the growth of *Pyronema,* we were inclined to abandon the toxin theory as an explanation of the failure of this fungus to grow on unheated-soil. It then occurred to us to reverse our experiments and try the effect of heated-soil extract with unheated-soil (p. 115). On December 2, a five-inch pot of soil was heated to a temperature of 175° C. for about two hours. This soil was then cooled and the pot placed over a filter in an extraction apparatus arranged for this purpose. Distilled water was poured into the pot until it percolated through the soil and filtered into the bottom of the extraction apparatus. A similar pot of the same kind of soil unheated was treated in the same manner. The extracts of the heated-soil and unheated-soil made in this manner were very different; the extract of the heated-soil was of a bright amber or reddish-brown color and very clear, while that of the unheated-soil was clear or slightly clouded but with no trace of the color characteristic of the heated-soil extract. The odor of the heated-

soil extract was also very characteristic, approaching that of the heated-soil itself, while the unheated-soil extract had the odor of ordinary moist earth.

When concentrated by evaporation, the residue from the heated-soil extract was of a dark brown color and possessed a very strong odor of caramel.

Other extracts of local soils were made with similar results. When heated at low temperature the color of the soil extract is often very pale, while the same soils when reheated at a higher temperature yield a much more highly colored extract, which indicates that high temperatures are necessary factors in producing a highly colored extract.

The production of an extract from heated-soil of apparently different composition from that obtained from unheated-soils and which possessed the odor characteristic of soils most favorable to *Pyronema* growth, suggested the possibility that after all we were dealing with a *food* problem, notwithstanding the fact that this had apparently been disproved by Kasaroff.

In order to test the effect of heat on other than local soils a sample of North Dakota soil was obtained through the kindness of Professor H. L. Bolley of the North Dakota Agricultural College. A sample of this soil was heated and an extract made as in previous experiments. The results were similar in every way except that the extract was of a much darker color (reddish-brown), a result which would naturally be expected by reason of the large amount of organic material in the soil. A more detailed account of the results of these tests will be given in Section VII.

Extracts of a Massachusetts soil sent by the kindness of Mr. M. G. Clark did not differ materially from extracts of local New York soils.

We should call attention here to the correlation between the temperatures necessary for the production of a strong or highly colored extract and those necessary in order to render the soil favorable to the growth of *Pyronema*. It has already been noted in a previous paper that the higher the temperatures to which the soils are heated (so far as our experiments had gone), the more favorable are the conditions for the growth of the fungus. We

have since found that the higher the temperature to which the soil is heated (up to 200° C.) the more favorable are the conditions for the production of a highly colored extract. This would at least suggest that the formation of this extract is directly concerned in the growth of *Pyronema*.

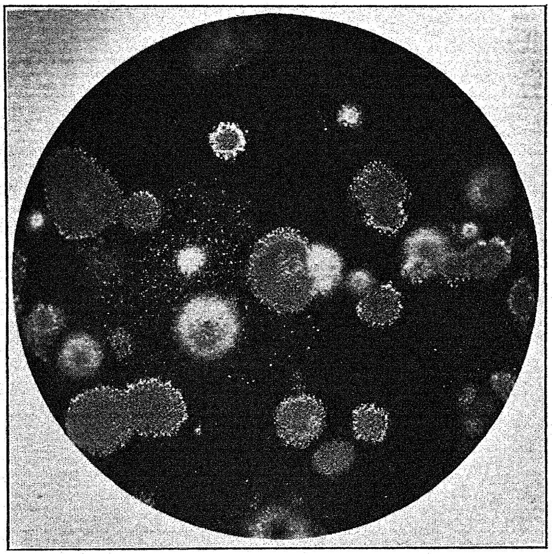
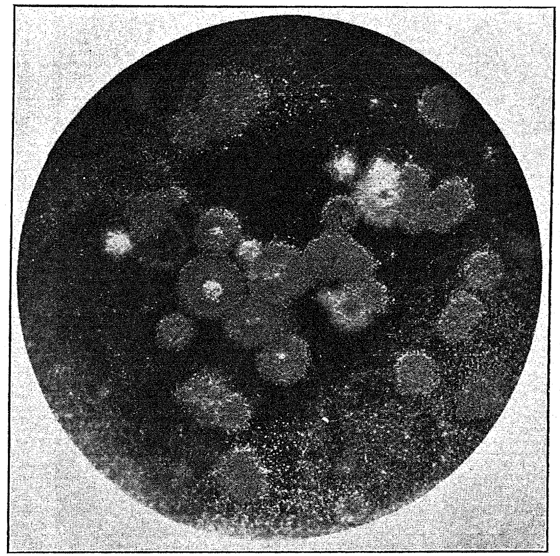
IV. BIOLOGICAL EXPERIMENTS WITH SOIL EXTRACTS

A number of extracts of heated soils were made and placed in tightly closed bottles, with no intention, however, of guarding against the possibility of air infection by fungi. Several of the extracts were evaporated down to various stages of concentration and all kept for experiment and study.

In a short time it was observed that a number of these extracts were infected with the mycelium of a fungus. In most cases the mycelium consisted of globose colonies varying from a few millimeters to a centimeter in diameter. Each consisted of a mass of mycelial threads radiating from a central point and apparently originating from a single spore. As the plants became older the mycelium became more fluffy and in some cases almost entirely filled the bottles containing the extract while in other cases the extract seemed to be less favorable for their continued growth. These colonies usually started near the bottom of the bottle, entirely immersed in the solution.

Some of this mycelium was removed from the bottles and placed on filter paper saturated with the extract. In several cases the fruit of *Pyronema* soon appeared and in some cases was produced in abundance, while in a few experiments no fruit was produced. From these experiments it became evident that the fungus which was infecting our extracts was *Pyronema*, as we had previously suspected and as the mycelium itself indicated.

So favorable are the heated-soil extracts as culture media for *Pyronema* that it has been found almost impossible to keep the extracts for any length of time in our laboratories without having them thoroughly infected with the fungus (*pl. 25, f. 2*). The same fact has already been noted with reference to heated-soil itself, this being so favorable as a nutrient medium for *Pyronema* that it is difficult to keep the fungus from invading

Two cultures of heated-soil extract self infected with fungi of various kinds, *Penicillium*, *Verticillium*, *Mucor* and *Pyronema*. Controls containing the extracts of the same soil before heating and exposed under the same conditions were entirely free from fungous infection.

these substrata when exposed in our laboratory where the spores are present from previous experiments.

As stated above, the extract of North Dakota soil is much darker in color than those of local soils, a result which would be expected since the soil itself is much blacker by reason of the large amount of organic matter present. We have shown by our experiments that the color of the extract is an index to the amount of soluble substances they contain. It would naturally follow that the extract of North Dakota soil is much richer and therefore a more favorable culture medium for *Pyronema* than the extract of the other soils studied, as our experiments have later shown.

In order to run a parallel test on the unheated-soil extract and heated-soil extract, three Petri dishes were partially filled with the highly colored extract of North Dakota soil and three similar dishes filled with the extract of the same soil unheated. These were placed side by side and loosely covered, allowing abundant opportunity for air infection. In a few days, the extract of the heated-soil showed an abundant infection consisting of numerous surface colonies of various kinds of fungi and a large number of immersed colonies of what appeared to be *Pyronema*. In about a week, two of the dishes showed abundant growth of *Pyronema*, the mycelium forming a very thin but tough membrane over the surface of the extract and the fruit being produced in great abundance over its surface, especially around the outsides of the culture (*pl. 24*). Although the mycelium of *Pyronema* had invaded our extracts continually these were the first cultures in which the fruit was produced in the extract. The controls containing the extract of unheated-soil showed no signs of infection by fungi of any kind.

The abundant infection of heated-soil extracts with *Pyronema* while the extracts of the same soil unheated remained uninfected, is strong evidence that the fungus appears here on account of the large amount of soluble food material liberated in the soil through the process of heating.

Numerous attempts to render unheated-soil favorable to *Pyronema* growth by the addition of heated-soil extract have failed to yield the expected results. Assuming that the extract contains food material for *Pyronema* it has been difficult to account for

these failures. There are however two possible explanations: (1) that the unheated-soil contains a toxin which retards the growth of the fungus even in the presence of abundant food material, which toxin is destroyed by heat, thus rendering our problem a double one; and (2) that the nature of the food material itself is changed by the action of the unheated-soil.

Our experiments indicate that these failures to render unheated-soil favorable for this fungus are due in part to the fact that the nature of the food material is changed when this is introduced into unheated-soil. This is shown by the fact that if a pot of unheated-soil is saturated with a concentrated extract of heated-soil (reddish-brown in color) and allowed to stand for a few days, it is found that the extract has almost entirely lost its color. This result may be due to chemical combination or to the adsorptive phenomena shown by many finely divided materials such as animal charcoal, which will completely decolorize large volumes of solutions containing dyes, etc. Quantitative studies of extracts treated in this manner show that the soluble materials have been reduced to approximately the same amount contained in extract of unheated-soil. This taking out of solution of the soluble materials in heated-soil extract when added to unheated-soil, seems to account for our failure to render unheated-soil favorable to *Pyronema* in this manner, but it is possible that there are other factors concerned. This is further suggested by the following observation: While it has been impossible to render unheated-soil favorable to *Pyronema* by the addition of heated-soil extract, heated-soil which is watered with the extract of other heated-soil is much more favorable than the same kind of soil treated with distilled water, as is shown by the fact that both mycelium and fruit of *Pyronema* are produced in much greater abundance on the heated-soil watered with the extract (*pl. 26*).

V. Heated-Soil and Its Extracts as Nutrient Media for Fungi

In a previous paper, attention was called to the fact that while heating of soil destroys fungi present at the time of heating, it prepares the way for the growth of those species which are intro-

duced subsequent to heating. This conclusion was drawn from the observation of such forms as *Verticillium, Fusarium,* and species of various other genera of the imperfect fungi which gain entrance to the soil through the planting of seeds. The growth of such fungi was much more abundant on heated- than on unheated-soil.

Our later experiments with heated-soil extracts confirm the above observation. In addition to *Pyronema* noted above, these extracts are immediately attacked by *Penicillium, Mucor, Aspergillus,* and a number of undetermined, imperfect fungi, which grow in abundance, entirely covering and filling the extracts, especially the stronger ones, while the extracts of the same soils unheated show no fungous growth whatever. The only way in which we have been able to preserve extracts of heated-soils in our laboratory is by sterilizing and tightly sealing them in bottles. In this way we have been able to preserve them in excellent condition, while if not sterilized and tightly sealed they are soon disintegrated through the action of bacteria and fungi (*pl. 25, f. 2*).

In our studies of the Iowa Discomycetes it has been observed that about five per cent. of the species of this group reported from Iowa occur only on burned places. That such habitats are unusually favorable to the growth of saprophytic fungi is beyond question.

It is likely that many of the beneficial results obtained through the sterilization of soils, which effects have been attributed to the destruction of harmful fungi and bacteria in the soil, are due more to the chemical changes accompanying sterilization than to the sterilization itself.

VI. DISTILLATES FROM HEATED-SOIL EXTRACTS

Some heated-soil extract of a brownish color was distilled to one half of its original volume and the distillate collected. The residual solution in the flask had the rather pleasant odor of the heated-soil extract but the distillate had the pungent odor which is also present in the original extract. Both the distillate and the liquid in the distilling flask were acid to litmus. We thought that possibly we had been able to separate the toxic from the non-toxic acid substances by their difference in volatility and for this reason

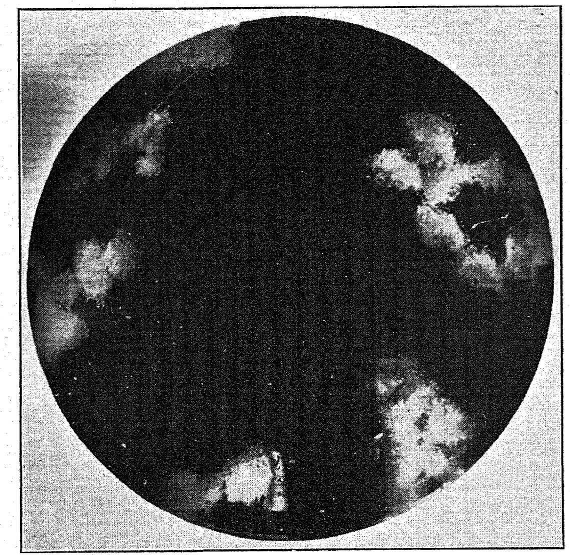
inoculated both liquids with the spores of *Pyronema*. In a week, the flask containing the dark-colored distillation residue was filled with the mycelium, while the other flask also had a considerable growth of *Pyronema*, the latter flask and liquid being perfectly transparent, with the silvery clumps of mycelium resting on the bottom of the flask (*pl. 25, f. 1*). Thus it seemed that distillation did not cause any appreciable separation of the substances in the extract, *i. e.*, judging from its effect on the growth of *Pyronema*.

VII. Chemical Studies of Soil Extracts

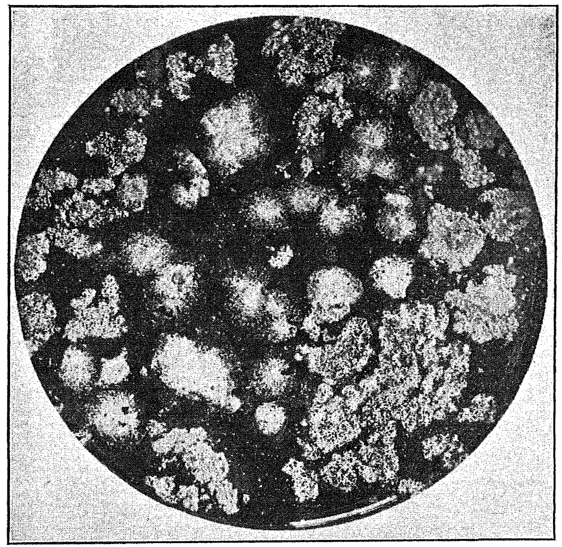
(*a*) Quantitative

As already noted, the color, odor, and general appearance of heated-soil extracts indicate that the composition of such extracts must be considerably different from that of extracts of unheated-soils. We decided to investigate first the quantitative differences between the extract of heated-soil and the same kind of soil unheated. The extracts which we analyzed were made by percolating the soils in 2 kg. samples with 2 liters of distilled water and taking 50 c.c. of the first liter of extract to come through, as the sample of the extract to be analyzed. The 50 c.c. samples of the extracts were evaporated to dryness in platinum dishes, dried at 108° to constant weight and this weight recorded as total solids. The residues were carefully ashed at a low, red heat, dried and weighed again, this weight recorded as inorganic matter and the difference between this weight and the weight of the total solids recorded as organic matter. We are aware that this method of determination of organic matter by difference of the weight obtained before and after ashing is not strictly accurate, but for the comparative purposes of this work this loss of weight may be used as a satisfactory measure of the organic matter present.

Determinations were made in this manner upon samples of New York soil, Massachusetts soil, and North Dakota soil. Since it had been noted that the percolation of an extract of heated-soil through an unheated-soil reduced and finally removed its color and again made it an unfavorable medium for *Pyronema* growth, we repeated this treatment with an extract of heated-soil whose composition was known and determined the change in com-



1. Colonies of *Pyronema* growing in the distillate of heated-soil extract.



2. Heated-soil extract infected with floating colonies of various kinds of fungi.

position after it had been acted on by the unheated-soil. The results of our work on the quantitative relations of soil extracts are presented in the following table:

INCREASE OF SOLUBLE MATTER IN SOIL UPON HEATING.

		Total solid matter. Per cent.	Organic matter. Per cent.	Inorganic matter. Per cent.
New York soil (1)	Unheated-soil extract	0.036	0.017	0.019
	Heated-soil extract	0.138	0.094	0.044
New York soil (2)	Unheated-soil extract	0.038	0.022	0.016
	Heated-soil extract	0.239	0.179	0.060
Massachusetts soil	Unheated-soil extract	0.016	0.008	0.008
	Heated-soil extract	0.249	0.197	0.052
North Dakota soil (1)	Unheated-soil extract	0.100	0.050	0.050
	Heated-soil extract	1.080	0.807	0.273
North Dakota soil (2)	Unheated-soil extract	0.101	0.037	0.064
	Heated-soil extract	0.986	0.758	0.228

DECREASE OF SOLUBLE MATTER IN HEATED-SOIL EXTRACT BY TREATMENT WITH UNHEATED-SOIL.

		Total solid matter. Per cent.	Organic matter. Per cent.	Inorganic matter. Per cent.
New York soil (2)	Before treatment	0.239	0.179	0.060
	After treatment	0.031	0.019	0.012
North Dakota soil (3)	Before treatment	0.756	0.576	0.180
	After treatment	0.100	0.052	0.048

In examining these results one is struck by the enormous increase of soluble matter produced by heating. This increase varies somewhat with different soils, depending upon the amount of organic matter present, the length of time heated, and the intensity of the heat, but in general the soluble matter in extracts of heated-soils is from six to ten times that contained in the extracts of the same soils before heating. The increase in the organic matter is greater than that in the inorganic matter, but still the latter is evidently increased several times. With such large amounts of both organic and inorganic matter made available in soils by heating, one can understand the preference of certain plants for places which have been burned over. It is interesting to note that where the heated-soil extract was percolated through and allowed to stand for a time with the unheated-

soil, the heated-soil extract was reduced to almost exactly the same condition as the extract of the same soil before heating.

(*b*) QUALITATIVE

We next undertook to investigate the nature of the substances that seemed to make heated-soil extracts favorable culture media for *Pyronema* and other fungi. The pungent odor of the extracts of heated-soil together with the pronounced acidity towards litmus suggested acids, while the dark color and caramel odor suggested carbohydrates or their decomposition products. The following tests were made on heated-soil extracts before being evaporated:

Litmus paper—red.
Lead acetate—brownish precipitate.
Silver nitrate—slight precipitate (not soluble in ammonia).
Barium chloride—slight precipitate.
Alcohol—slight precipitate.
Calcium hydroxide—slight precipitate.
Ether—does not dissolve color of solution.
Molisch test—positive.

This same extract when evaporated to one fiftieth its original bulk showed the same reactions in every case except that they were far more pronounced. This concentrated extract also caused a strong reduction of Fehling solution while the blanks were negative. All of the above tests were repeated many times and the results were practically always in accord with those described above.

When unheated-soil extracts were tested in exactly the same manner, the acidity was slight as shown by litmus, barium chloride gave a slight precipitate (owing to sulphates), and silver nitrate also gave a slight precipitate wholly soluble in ammonium hydroxide (probably owing to chlorides), while all the other tests were negative.

From the qualitative tests just described we are inclined to believe that upon heating to about 160° to 180° C., the organic matter in the soil undergoes some deep-seated changes probably oxidative in nature, favored by the high temperatures, which give us the water-soluble products of an acid character producing the dark-colored solutions. The acidity of heated-soil extracts

and the heavy precipitates obtained with lead acetate, silver nitrate, and calcium hydroxide, might well be due to the presence of organic acids. The positive Molisch test indicates carbohydrates or their decomposition products, while the strong reducing action on Fehling solution would seem to confirm the assumption that carbohydrate substances are present. It is not at all impossible that the partially disintegrated cellulose of the bodies of plants previously growing on the soil, would be broken up into still smaller fragments of the original enormous molecule, and that these smaller fragments would still retain some of their carbohydrate characteristics together with the added one of acidity.

We next examined the ash of the North Dakota heated-soil extract in a qualitative manner to discover if possible the nature of the inorganic substances in the extract. The ash of the North Dakota soil was used for the reason that this was obtained in considerable quantity and that the extract of this soil was unusually favorable as a culture medium for fungi, probably owing to the large amount of organic matter originally present in the soil. The ash of the *unheated* North Dakota soil was pure white and soluble in water (100 c.c.). Upon analysis the ash was found to consist principally of the sulphates of sodium, potassium, magnesium and calcium; we were however able to find scarcely a trace of phosphates. About one-half of the ash of the extract of *heated* North Dakota soil was found to be soluble in water. In the soluble portion of the ash, sulphates of potassium, sodium, magnesium and calcium, etc., were found. In the insoluble part of the ash, we found principally calcium sulphate with some manganese, iron and traces of phosphates, etc. Calcium is thus seen to be present in considerable quantities in the extracts of heated- and unheated-soils and it may be, from the well-known stimulating and protective properties of calcium toward plants, that this element along with the organic matter helps to give heated soils some of their striking properties.

Just as this work was being brought to a close we received, upon request, a copy of an article (in galley proof) by Professor T. L. Lyon, who is publishing the results of his investigations on the effects of steam sterilization upon soils. With steam heat he found the same great increase of soluble matter over

unheated-soils that we found in the case of dry heat at 180° C. He also calls attention to the same disappearance of this soluble organic matter when soils were allowed to stand after steam sterilization, that we had noted in our work on *Pyronema*. All this shows that either dry or steam heat may cause very important changes in soils and that it is to the effect of these changes on plants, as well as to the destruction of bacteria, etc., that we must ascribe the cultural results often noted in our experiments with heated-soils.

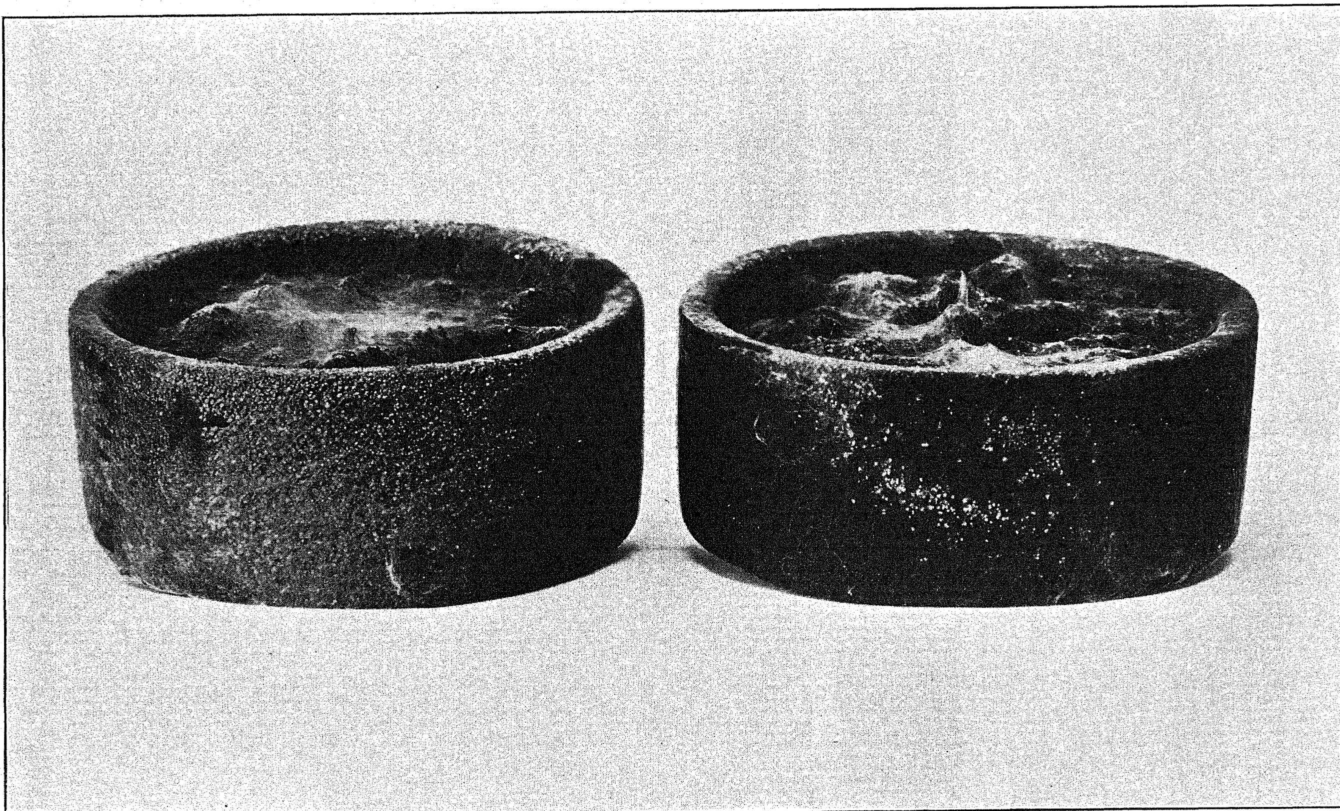
VIII. Products of Dry Distillation of Soil

In order to see if the heating of a soil would drive off substances toxic to *Pyronema*, we filled a combustion tube with soil, put it in the furnace, fitted to the tube a smaller glass tube opening under a receiver of distilled water and heated the soil. Steam came over first and then more and more of a yellowish oil which was partially suspended in the water and partially formed a scum on the surface. The oily substance had an intensely irritating and nauseating odor like that of an old, stale pipe and recalled pyridine or its allies. The liquid in the receiver was alkaline to litmus. All of this seemed to indicate pyridine bases. We watered some heated-soil with this liquid and inoculated it with *Pyronema*. In a week, the growth on this soil was as good as that on the control watered with distilled water.

The soil left in the tube was black. This was watered with distilled water and inoculated with the spores of *Pyronema* but proved to be unfavorable to its growth, although some mycelium was produced.

IX. Identity of the Fungus

The fungus which we have been cultivating in the laboratory had been determined by us as *Pyronema omphalodes* (Bull.) Fuckel, although its appearance in the laboratory differed slightly from specimens of this species previously observed by us in the field. In nature the ascocarps of this species give rise to dense, confluent masses in which it is difficult to recognize the individual ascocarps, while in the laboratory the plants are thickly gregarious but not confluent to the extent that they are in nature. It therefore occurred to us that the species might be distinct.



Both pots of soil heated, the one to the left watered with heated-soil extract and the one to the right with distilled water ; to show the improvement of heated soil for *Pyronema* by the addition of more extract.

In order to prove the identity of the species, in the spring of 1908 a pile of dead grass and leaves was raked together on the ground and burned, giving rise to a burnt place similar to those on which *Pyronema omphalodes* (Bull.) Fuckel was known to occur. As soon as the first rain occurred after the burning of this material a few of the plants from the laboratory were placed in the ashes and on the ground where the fire had been. In about ten days a good growth of *Pyronema omphalodes* (Bull.) Fuckel was found, the plants occurring in confluent masses as usual. These plants were taken into the laboratory and inoculations made from them on heated-soil. These at once produced mycelium radiating out from the point of infection and later produced an abundance of fruit, the ascocarps being scattered as is usually the case in laboratory grown material.

Some of the laboratory plants show rather well developed, hyaline, septate hairs, although these are not a conspicuous character. The color also varies much from bright rose or salmon to almost white. The paler plants are usually those produced on less favorable substrata. The fungus has doubtless been described under several names.

SUMMARY

1. Contrary to the statement of Kasaroff, our experiments have failed to show the presence of a soluble, toxic substance in unheated-soil which will retard the growth of *Pyronema* when applied to heated-soil.

2. Heating the soil to a high temperature brings about chemical changes indicated by the following: (*a*) The extract of heated-soil is of a bright amber or reddish-brown color and possesses a characteristic odor while the extract of unheated-soil is colorless and almost odorless, (*b*) the amount of soluble material in the extract of heated-soil is increased to approximately* six to ten times that of the extract of the same soil unheated.

3. The materials rendered available by the heating of the soil serve as food for *Pyronema*, as is indicated by the following: (*a*) The conditions necessary for the production of a highly colored extract in soil are the conditions most favorable to the growth

* The exact increase will vary with the soil and manner in which it is treated, temperature, length of time heated, etc.

of *Pyronema,* (*b*) the extract of heated-soil is itself so favorable as a culture medium that it is at once attacked by the fungus while the extract of the same soil unheated remains uninfected, (*c*) heated-soil watered with the extract of another heated-soil is much more favorable to *Pyronema* growth than similar soil watered with distilled water, the former producing mycelium and fruit in much greater abundance.

4. Distillation of heated-soil extract does not remove the properties favorable to *Pyronema,* both the colorless distillate and the highly colored distillation residue being favorable to its growth, the distillation residue, however, appearing to be more favorable than the distillate.

5. Excessive heating of soil in a combustion-tube renders it unfavorable to *Pyronema* growth. The distillate has a very offensive odor but is apparently neutral to *Pyronema* growth when applied to heated-soil.

6. It has been impossible to render unheated-soil favorable to the growth of the fungus by the introduction of the extract of heated-soil, this being apparently due to the fact that the nutrient materials in the extract are rendered insoluble by the action of unheated-soil.

7. Not only is the extract of heated-soil a favorable nutrient medium for *Pyronema,* but for other fungi as well, indicated by the fact that the extract is attacked by fungi of various kinds.

8. Soil subjected to steam or dry heat (either in a closed oven or by burning over the surface of the soil), becomes a very favorable nutrient medium for fungi of various kinds, by reason of the large quantity of food material rendered available through the heating of the materials in the soil.

We wish to acknowledge our indebtedness to Dr. W. J. Gies, of the Department of Biological Chemistry of Columbia University and Consulting Chemist to the New York Botanical Garden, for his oversight and aid throughout the course of the present work. We also extend thanks to Dr. Oswald Schreiner, of the Bureau of Soils, Washington, for numerous suggestions on various questions which have arisen pertaining to matters of soil fertility.

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THE NORTH AMERICAN MUCORALES—I

Family MUCORACEAE

DAVID ROSS SUMSTINE

INTRODUCTION

The Mucoraceae have attracted the attention of botanists for more than two hundred years and from the number of papers and theses published on the subject in Europe recently the interest remains unabated.

The American species have never been studied systematically, although local and state lists of fungi contain the names of the more common species. Pound* describes the American genera and enumerates a few species. The splendid work of Blakeslee† deals entirely with zygospore formation.

The synonymy is exceedingly complicated and the status of many described species cannot be definitely determined. Lendner‡ reports seventeen imperfectly described species in the genus *Mucor* appearing from 1884 to 1906. The rule of priority has frequently been ignored and the same name has been used for different species. Fischer§ has unraveled the intricate synonymy of the European species.

Dried specimens soon lose their taxonomic characters, and therefore herbarium material, even when available, is seldom satisfactory for the exact determination of the specimens. The viability of the spores is lost in three to ten months and consequently cultures cannot be made from old material in order to establish the true identity of the specimens.

While this paper is intended primarily to enumerate only species seen and examined by the writer, yet, for the purpose of giving a better survey of the American species, a few have been admitted on the authority cited under Species Reported.

* Minn. Bot. Studies 1: 87–104. 1894.

† Proc. Am. Acad. 40: 205–319. 1904.

‡ Les Mucorinees de la Suisse 100. 1908.

§ Rabenh. Krypt. Fl. 1892.

At the conclusion of these studies, my own material will be placed in the Carnegie Museum, Pittsburgh, and in the New York Botanical Garden. This will be done in the hope that other mycological workers who are not directly connected with large public institutions will also deposit their material in institutions where it will be available to future students.

I am indebted to Dr. W. J. Holland, of the Carnegie Museum, Pittsburgh, for assistance in making collecting trips in Pennsylvania. My thanks are especially due to Dr. N. L. Britton for the opportunity of examining the specimens in the herbarium and consulting the literature in the library of the New York Botanical Garden. The various members of the staff of the Garden have very kindly and cheerfully rendered valuable service in the preparation of this paper.

Order MUCORALES

Saprophytic or parasitic fungi with well-developed mycelium, the mycelium branched and unicellular. Reproduction sexual (zygospores) and asexual (spores produced in sporangia or conidia produced singly or in chains).

Schroeter* recognizes five families, *Mucoraceae*, *Mortierellaceae*, *Choanophoraceae*, *Chaetocladiaceae*, and *Piptocephalidaceae*. The total number of species for the whole world is less than 150. Most of these are described from Europe.

Family MUCORACEAE

Asexual reproduction by spores in sporangia with columella or sometimes in sporangioles without columella. Sexual reproduction by zygospores formed on the mycelium or on aerial filaments by the union of two copulating branches (gametes).

KEY TO THE GENERA

1. *Simplices*

Sporangiophores simple, unbranched.
  Sporangiophores arising from stolons, sporangial membrane not cuticularized.
    Sporangiophores arising from the nodes of the stolons. — 1. MUCOR.
    Sporangiophores arising from the internodes of the stolons. — 2. ABSIDIA.

* Pflanzenfamilien 1[1]: 123. 1892.

Sporangiophores arising from the mycelium, sporangial membrane not cuticularized.
- Sporangiophores long, with metallic luster. 3. PHYCOMYCES.
- Sporangiophores variable in length, white, gray, brown. 4. HYDROPHORA.
- Sporangiophores brown or brownish with spiny aërial filaments. 5. SPINELLUS.

Sporangiophores arising from the mycelium or from mycelial swelling, sporangial membrane cuticularized.
- Sporangiophores arising from mycelial swellings. 6. HYDROGERA.
- Sporangiophores not as above. 7. PILAIRA.

2. *Ramosi*

Sporangiophores variously branched.
- Sporangiophores dichotomously branched. 8. SYZYGITES.
- Sporangiophores without terminal sporangia, branches circinate. 9. CIRCINELLA.
- Sporangiophores with terminal sporangia, branches with sporangioles.
  - Sporangioles on dichotomous branches. 10. THAMNIDIUM.
  - Sporangioles on circinate branches. 12. HELICOSTYLUM.
  - Sporangioles on straight branches, arising from bulbs. 11. BULBOTHAMNIDIUM.
- Sporangiophores with sporangia only.
  - Branches long or short, zygospores with nearly equal suspensors. 13. CALYPTROMYCES.
  - Branches as above, zygospores on dichotomous branches, suspensors unequal. 14. ZYGORHYNCHUS.

1. MUCOR (Mich.) L., Sp. Pl. 1185. 1753

Ascophora Tode, Fung. Meckl. **1**: 13. 1790.

Type species, *Ascophora Mucedo* Tode.

Rhizopus Ehrenb. Nov. Acta Acad. Leopold **10**[1]: 198. 1820.

Type species, *Rhizopus nigricans* Ehrenb.

ORIGINAL DESCRIPTION: Fungus vesicula subrotunda, in qua semina numerosa affixa, receptaculis criniformibus constans.

Type species, *Mucor Mucedo* L.

Sporangiophores simple, usually growing in clusters of two, three, or five from the nodes of the stolons, enlarged below the sporangia forming an apophysis; mycelium white at first, then brown, growing by stolons attached at different places to the substratum by rhizoids; zygospores borne on the mycelium, naked.

Robert Hooke (Micrographia 125, *pl. 12, f. 1.* 1665) describes and figures a mushroom growing on "divers kinds of putrefied bodies, such as skin raw or dressed, flesh, blood, milk, green cheese, rotten sappy wood, or herbs, leaves, bark, roots of plants." The plants were also found "to bespeck and whiten over the red covers of a small book bound in sheep skin. This kind of leather gathers mould more easily than other leathers."

The plants are described as long, cylindrical with transparent stalks bending over with the weight of a round knob that grows on the top of them. The illustrations might easily be our common black mould but the habitat makes it somewhat doubtful.

Malpighius (De Plant. in aliis Veg. 65. *pl. 28, f. 108.* 1687), describes and figures accurately the so-called *Mucor stolonifer.* He observed the plants "*in Cucurbitae putrescente pericarpio.*" He observed clearly the rhizoids, *radicibus minimis,* and the clusters of sporangiophores arising from the nodes of the stolons "sometimes five, sometimes three, and not rarely two." His description and discussion leave no doubt as to the identity of his plants (see Wilson, Bull. Torrey Club 33: 557. 1906).

Micheli *l. c.* first establishes the genus *Mucor* and divides it into two sections, *Mucores pediculo donati* and *Mucores pediculo-carentes.* The first species enumerated is *Mucor vulgaris* and characterized as follows, "*capitulo lucido per maturitatem nigro, pediculo griseo.*" He cites Malpighius, Hooke and Sterbeeck. The brief description and the illustration are not conclusive as to the identity of his species but when studied in connection with his observations, it is very evident that he had before him *Mucor stolonifer.*

In the Species Plantarum, Linnaeus enumerates under the genus *Mucor* eleven species but only one, *Mucor Mucedo,* is now retained under the genus, which becomes the type of the genus. He cites *Mucor vulgaris* of Micheli as a synonym. Without doubt, *Mucor vulgaris* and *Mucor Mucedo* refer to the same plant. A careful study of the above citations leaves no doubt as to the identity of the plants of Malpighius, Micheli and Linnaeus.

The following citations may be given as additional or corroborative evidence that the early botanists had before them the *Mucor Mucedo* of Linnaeus with the identity as above indicated:

Gleditsch (Meth. Fung. 158 seq. 1753) describes a number of Mucors among which is *M. vulgaris*. He cites Micheli, Malpighius and Linnaeus. Haller (Hist. Stirp. Helv. 3: 113. 1768) lists *Mucor Mucedo* growing on bread. Batsch (Elench. Fung. 157. 1783) enumerates and describes six Mucors. The first one is *Mucor Mucedo*. Fries (Syst. Myc. 3: 310. 1829) lists *Ascophora Mucedo* but gives as synonym *Mucor Mucedo, Auct. pro parte*. The description fits very clearly the species under consideration.

These various names were applied to the plant of Linnaeus until 1850, when Fresenius (Beitr. Myk. 4–13. *pl. 1, f. 1–12.* 1850) described and figured quite a different plant under the name *Mucor Mucedo*. His plant was no other than *Hydrophora stercorea* Tode (see under *Hydrophora*), and quite distinct from *Mucor Mucedo* L. But since the time of Fresenius many authors have considered *Mucor Mucedo* L. and *Mucor Mucedo* Fres. synonymous, although the plants described by these two men are very different.

Zimmerman (Das Genus Mucor 4. 1870) recognized the real identity of *Mucor Mucedo*. He says that the description and figure of Malpighius undoubtedly refer to *Mucor stolonifer* Ehrenberg but he ignores the *Mucor Mucedo* of Linnaeus.

KEY TO THE SPECIES

Rhizoids abundant, at the nodes of the stolons, spores large, irregular.	1. *M. Mucedo.*
Rhizoids few, short, spores smaller, oval or round.	2. *M. arrhizus.*
Rhizoids few, sporangiophores with swellings.	3. *M. nodosus.*

1. MUCOR MUCEDO L. Sp Pl. 1185. 1753. Not *Mucor Mucedo* Fres.

Ascophora Mucedo Tode, *l. c.* 1790.
Mucor stolonifer Ehrenb. *l. c.* 1818.
Rhizopus nigricans Ehrenb. *l. c.* 1820.
Mucor ascophorus Link, Willd. Sp. Plant. 6^1: 85. 1824.

See Fischer *l. c.* for further synonymy.

This is the common black mould of bread and of decaying vegetable matter. The shape and the size of the spores are exceedingly variable.

SUBSTRATA: On bread, pumpkin, squash, sweet potato, fruits.

SPECIMENS EXAMINED: Delaware, *Cummins;* Kansas, *Fung. Columb. 1673;* Kingston, Jamaica, *Ellis Collection 66;* New Jersey, *Ellis Collection 1628;* New York, *Underwood* and *Cook 89;* Nebraska, *Pound;* Pennsylvania, *Sumstine;* South Carolina, *Ravenel 622, 89;* Washington, D. C., *Galloway.*

ILLUSTRATIONS: Malpighius, *l. c. pl. 28, f. 108, e, f, g;* Corda, Icon Fung. 1: *pl. 11, f. 78, pl. 12, f. 83;* Link, Ges. Naturf. Freunde Berl. Mag. **3**: *pl. 2, f. 43;* Fischer, *l. c. f. 39.*

2. MUCOR ARRHIZUS (Fischer) Hagem, Norweg. Mucorineen 37. 1908

Rhizopus arrhizus Fischer, *l. c.* 233. 1892.

The stolons are less developed than in the preceding species; the sporangiophores grow from the nodes in umbels or corymbs; the spores are round or oval, irregular, angular.

SUBSTRATA: On bread.

SPECIMENS EXAMINED: Pennsylvania, *Sumstine.*

ILLUSTRATIONS: Hagem, *l. c.*

3. **Mucor nodosus** (Namysl.).

Rhizopus nodosus Namysl. Bull. Acad. Sci. Cracovie. 1906. (This paper was not available.)

The few rhizoids, the branching sporangiophores, the somewhat flattened columella, and the peculiar nodes or swellings in the sporangiophores characterize this species.

SUBSTRATA: On sterilized bread.

SPECIMENS EXAMINED: Pennsylvania, *Sumstine.*

ILLUSTRATIONS: Lendner, *l. c.* 122.

SPECIES REPORTED

Mucor rhizopodiformis Cohn, Zeitschr. f. Klinische Medicin **7**: 148. 1884. *Rhizopus Cohnii* Berlese & de Toni; Sacc. Syll. Fung. **7**: 213. 1888.

No. 1950 in the Ellis Collection is labeled *Rhizopus Cohnii.* The plants were found growing "in kraut barrel attached to sides." The spores are small and regular in form. Attempts to germinate some of the spores were unsuccessful. The species is considered pathogenic in dogs and rabbits.

DOUBTFUL SEPCIES

Mucor inaequalis Peck, Ann. Rep. N. Y. State Mus. **26**: 79. 1874.

2. ABSIDIA Van Tieghem, Ann. Sci. Nat. VI. **4**: 350. 1876

ORIGINAL DESCRIPTION: En résumé, les *Absidia* sont caractérisés vis-à-vis de toutes les autres Mucorinées: 1° par le développement de leur appareil sporangial en arcades paraboliques, issus l'une de l'autre en sympode et couronnées chacune par un bouquet de sporanges piriformes; 2° par les rameaux verticillés, cuticularisés et colorés, qui viennent envelopper et protéger la zygospore.

Ces caractères placent ce genre entre le *Rhizopus* et le *Phycomyces,* mais plus près du premier. (In part.)

Type species, *Absidia capillata* Van Tieghem.

Sporangiophores in groups of 2–5, developed from the internodes of the stolons, terminated by a pear-shaped sporangium with columella; zygospores produced on the stolons, enveloped by circinate, cuticularized filamentous threads growing from the suspensors.

1. ABSIDIA SPINOSA Lendner, Mucor. Suisse 132. 1908

? Absidia cylindrospora Hagem, Unters. Norweg. Mucor. 45. 1908.

Lendner gave a preliminary description of this species in Bull. de l'Herb. Boissier II, **7**: No. 3. 1907. The spine growing from the extremity of the columella suggested the name *spinosa.*

SUBSTRATA: Grown in the laboratory on sterilized bread.

SPECIMENS EXAMINED: Pennsylvania, *Sumstine* (laboratory culture).

ILLUSTRATION: Lendner, *l. c. f. 46.*

3. PHYCOMYCES Kunze, Myk. Hefte **2**: 113. 1823

ORIGINAL DESCRIPTION: Flocci decumbentes, continui, simplices, flaccidi. Sporidia oblonga circa vesiculam pyriformem apice insidentem collecta.

Type species, *Ulva nitens* Agardh, Syn. Alg. Scand. 46. 1817.

Sporangiophores erect, simple, terminated by a large sporangium, growing singly from the mycelium; zygospores borne on the mycelium, suspensors with dichotomously branched outgrowths, copulating branches tong-shaped.

1. PHYCOMYCES NITENS (Agardh) Kunze, *l. c.* 1823

Ulva nitens Agardh, *l. c.* 1817.

Periconia phycomyces Bonord. Hbdk. Allg. Myk. 113. 1851.

Mucor romanus Carnoy, Bull. Soc. Royal Bot. Belg. 9: 157. 1870.

Mucor violaceus Bref. Bot. Unters. 4: 56, 92. 1881.

The large, metallic-like sporangiophores enable one to identify this species even without lens or microscope. It prefers oily or greasy substances and can easily be grown on ground flax seed. It has been reported as growing on a mushroom, *Collybia dryophila* (Bull.) Fr. (Peck, Ann. Rep. N. Y. State Mus. 31. 1909).

SUBSTRATA: On ground flax seed, cornmeal, horse manure.

SPECIMENS EXAMINED: North Carolina, *Wood;* New York, *Mrs. N. L. Britton;* Oregon, *Lake;* Pennsylvania, *Sumstine, Schweinitz.*

ILLUSTRATIONS: Carnoy, *l. c. pl. 1, f. 1–4, pl. 2, f. 1–3, pl. 3, f. 1–7;* Van Tieghem, Ann. Sci. Nat. V. 17: *pl. 20;* Bainier, Étude, *pl. 1, f. 12–15.*

4. HYDROPHORA Tode, Fung. Meckl. 2: 5. 1791

Mucor (Mich.) L. (Many authors since 1850.)

ORIGINAL DESCRIPTION: Fungus globosus, stipitatus, capitulo aqueo; stipite capillari subrecto; fructificatione ignota.

Type species, *Hydrophora stercorea* Tode.

Sporangiophores simple, arising singly from the mycelium, terminated by a sporangium with columella; zygospores borne on the mycelium, naked, copulating branches straight. The species under Section 1. Mono-Mucor, of Fischer (Rabenh. Krypt. Fl. 1^4: 184. 1892), belong to this genus.

Under this genus, Tode placed three species, *H. minima,** *tenella,*† *stercorea.* The descriptions of the first and second are

* Fischer (Rabenh. Krypt. Fl. 1^4: 297) thinks this is a *Syncephalis,* probably *S. nodosa.*

† See under *Pilaira* for further discussion.

too indefinite for exact determination. The characterization of the third species seems to agree with the plants now usually passing under the name *Mucor Mucedo* L. Tode found his plants on human dung but he also discovered some plants on dog dung which agree in every way with the former except in size.

There may be some doubt as to the absolute identity of Tode's plants but authors generally have cited his name as a synonym of the so-called *Mucor Mucedo* L. It is, at least, the oldest name given to dung inhabiting Mucors with simple sporangiophores unless some one can prove that Haller's species, *Lycogola petiolatum, aquosum, flavescens,* is a *Mucor* (Haller, Hist. Stirp. Helv. 3: 112. 1768).

KEY TO THE SPECIES

Sporangiophores erect.	
Columella cylindric or somewhat globose.	1. *H. stercorea.*
Columella pear-shaped.	2. *H. Fischeri.*
Sporangiophores flaccid, decumbent.	
Sporangia and sporangiophores brownish or yellow-brown.	3. *H. Taeniae.*
Sporangia and sporangiophores yellow or refusecent.	4. *H. rufescens.*

1. HYDROPHORA STERCOREA Tode, *l. c.* 1791

? Mucor caninus Pers. Obs. Myc. **1**: 96. 1796.

Mucor stercoreus Link, Willd. Sp. Pl. 6^1: 90. 1824.

Mucor Mucedo Fres. Beitr. Myc. 7. 1850. Not *Mucor Mucedo* L.

Mucor Mucedo L. (Many authors since 1850.)

This plant varies considerably in the size of the sporangia and the spores but the shape of the spores is rather constant. I have not found branching sporangiophores although they have been reported (Lendner, Mucor. Suisse 68. 1908). The species is also considered pathogenic (Neveu-Lemaire Precis de Parasitologie humaine. 1906).

SUBSTRATA: On human and horse dung.

SPECIMENS EXAMINED: Indiana, *Arthur;* New Jersey, *Ellis N. A. F. 972;* Pennsylvania, *Sumstine.*

ILLUSTRATIONS: Fres. *l. c. pl. 1, f. 1–12;* Fischer, Rabenh. Krypt. Fl. 1^4: *f. 30–31.*

2. **Hydrophora Fischeri** nom. nov.

Mucor piriformis Fischer, *l. c.* 191. 1892.

Not *Mucor pyriformis* Leers, Fl. Herborn. 288. 1789.

It is unfortunate that Fischer's name had been used before and therefore must be reduced to synonymy. The pear-shaped columella suggested the name given by Fischer.

The specimens referred to this species have a smaller columella and larger spores than those given in the original description (see Torreya **9**: 143. 1909).

SUBSTRATA: On dung of deer.

SPECIMENS EXAMINED: Pennsylvania, *Sumstine.*

ILLUSTRATIONS: Fischer, *l. c. f. 30 c.*

3. **Hydrophora Taeniae** (Fairman).

Mucor Taeniae Fairman, Proc. Roch. Acad. Sci. 533. 1891.

The author of this interesting species gives the following description, "Sporangiferous hyphae erect, rarely if ever branched septate, yellow, 7μ diam.

"Sporangia globose, brownish or yellow brown, smooth, mostly 40μ in diam. Columella elliptical or sub-sphaeroidal, at times with contraction at the base, brownish.

"Spores globose, or ellipsoid, light yellow, 3–5μ in diam. with smooth epispore. Zygospores not observed."

SUBSTRATA: On segments or joints of tape worm (*Taenia solium*).

SPECIMENS EXAMINED: New York, *Fairman.*

ILLUSTRATIONS: Fairman, *l. c. pl. 4, f. 4–6.*

4. **Hydrophora rufescens** (Fischer).

Mucor rufescens Fischer, *l. c.* 192. 1892.

Mucor rubens Vuillemins, Bull. Soc. Myc. Fr. **3**: 111. 1887.

Vuillemin's description is incomplete but in all probability he had the same plant before him as Fischer. The latter author cites *Mucor rubens* as a synonym of his species.

The sporangiophores are very flaccid and form a network over the substratum.

SUBSTRATA: On elephant dung.

SPECIMENS EXAMINED: New York, *Sumstine.*

SPECIES REPORTED

Mucor mucilagineus Bref. Bot. Unters. **4**: 58. 1881.

This species has been reported from Michigan by Kauffman (Ann Rep., Mich. Acad. Sc. **8**: 28. 1905). The author appends a note as follows, "Probably a variety of the type from which it differs slightly. On decaying fungi."

5. SPINELLUS Van Tieghem, Ann Sci. Nat. VI. **1**: 66. 1875

ORIGINAL DESCRIPTION: Par leur mycélium aérien, dont les filaments se cuticularisent, brunissent et se couvrent de petits rameaux épineux, par leur tube fructifère également cuticularisé et coloré en brun foncé, y compris la columelle qui s'insère au-dessus du point d'attache du sporange sur le filament, par leurs spores noirâtres, enfin par la courbure en mors de pince des deux rameaux renflés qui se conjuguent pour former la zygospore, ces deux espèces se distinguent de tous les *Mucor* à moi connus et doivent former un genre distinct, qui vient se placer entre le *Phycomyces* et le *Rhizopus,* non loin du *Sporodinia.* Son nom, *Spinellus,* est tiré des petites épines qui herissent les filaments mycéliens et dont le développement est lié au mode de nutrition et au parasitisme de ces plantes.

Type species, *Mucor fusiger* Link = *Mucor rhombosporus* Ehrenb.

Sporangiophores erect, simple, brown or yellowish-brown, with thorny, branched aerial filaments bearing the zygospores.

KEY TO THE SPECIES

Spores narrowly ellipsoid with obtuse or rounded ends.	1. *S. rhombosporus.*
Spores broadly ellipsoid with acute ends.	2. *S. macrocarpus.*

1. SPINELLUS RHOMBOSPORUS (Ehrenb.) Pound, Minn. Bot. Studies **1**: 96. 1894

Mucor rhombosporus Ehrenb. Syll. Myc. Berol. 25. 1818.

Mucor fusiger Link, Verh. Naturf. Freunde Berl. Mag. **1**: 108. 1820.

Spinellus fusiger Van Tieghem, *l. c.* 1875.

This species grows on agarics, especially species of *Mycena.* The aerial filaments with thorny branches and the spores with obtuse ends distinguish it.

Ehrenberg described the species first as *Mucor rhombosporus*

but later says that he made a mistake in the examination of the spores. Link suggested verbally to him the name *Mucor fusiger* which Ehrenberg prefers and accepts but according to the rules of priority the former name must be retained.

SUBSTRATA: On decaying agarics.

SPECIMENS EXAMINED: Pennsylvania, *Sumstine.*

ILLUSTRATIONS: Van Tieghem, *l. c. pl. 1, f. 29–37;* Bainier, Étude, *pl. 3, f. 1–13.*

2. SPINELLUS MACROCARPUS (Corda) Karst., Myc. Fenn. **4**: 73. 1878

Mucor macrocarpus Corda, Ic. Fung. **2**: 21. 1838.

This species differs from the other chiefly in spore character as shown in the key.

SUBSTRATA: On decaying agarics.

SPECIMENS EXAMINED: Pennsylvania, *Sumstine.*

ILLUSTRATION: Corda, *l. c. pl. 12, f. 84.*

6. HYDROGERA Web. and Wigg., Prim. Fl. Holsat. 110. 1780.

Pilobolus Tode, Schrift. Gesell. Naturf. Freunde Berl. **5**: 46. 1784.

Type species, *Pilobolus crystallinus* (Web. and Wigg.) Tode.

ORIGINAL DESCRIPTION: Capsula humido aquoso repleta, pileo hemisphaerico tecta.

Type species, *Hydrogera crystallina* Web. and Wigg.

Sporangiophores simple, erect or oblique, colorless or with orange colored contents, arising from swellings in the mycelium and ending with ellipsoid swellings beneath the sporangium; sporangia lenticular, with columella, membrane cuticularized above but disappearing in the lower half; zygospores borne on the mycelium, naked, with tong-shaped copulating branches.

KEY TO THE SPECIES

Spores elliptic.	
Spores small, 3–6 × 6–10 μ.	1. *H. obliqua.*
Spores variable, larger, 6–10 × 12–20 μ.	2. *H. Kleinii.*
Spores ellipsoid or nearly globose, 10–12 × 12–14 μ.	3. *H. longipes.*
Spores globose, variable in size.	4. *H. Oedipus.*

1. HYDROGERA OBLIQUA (Scop.) O. Kuntze, Rev. Gen. Pl. 2: 855. 1891

Mucor obliquus Scop., Fl. Carn. 2: 494. 1772.
Hydrogera crystallina Web. and Wigg., *l. c.* 1780.
Pilobolus crystallinus (Web. and Wigg.) Tode, *l. c.* 1784.
? *Mucor urceolatus* Dicks., Pl. Crypt. Brit. 1: 25. 1785.

Scopoli gives a good description of this species and Weber and Wiggers cite his species as follows, "*Mucor obliquus* Scop. Carn. n. *1643 cum nostra convenit.*" Tode bases his genus on *Hydrogera crystallina* and cites as a synonym *Mucor obliquus.* The sporangium rests somewhat on the side of the subsporangial swelling. The mycelial swelling is buried in the substratum.

SUBSTRATA: On dung of horse.

SPECIMENS EXAMINED: Pennsylavnia *Ellis & Ev. N. A. F. 831, Sumstine;* New York, *Sumstine.*

ILLUSTRATIONS: Tode, *l. c. pl. f. 1–7;* Link, Ges. Naturf. Freunde Berl. Mag. 3: *pl. 2, f. 49–50;* Bull. Herb. Fr. *pl. 480, f. 1.*

2. HYDROGERA KLEINII (Van Tieghem) O. Kuntze, *l. c.* 1891

Pilobolus Kleinii Van Tieghem, Ann. Sc. Nat. VI. 4: 337. 1876.

This species is nearest *H. obliqua* but may be distinguished by the form of the spores, by the mycelial swelling, and by the smaller sporangiophores.

SUBSTRATA: On horse dung.

SPECIMENS EXAMINED: Pennsylvania, *Sumstine.*

ILLUSTRATIONS: Van Tieghem, *l. c. pl. 10, f. 6–10.*

3. HYDROGERA LONGIPES (Van Tieghem) O. Kuntze, *l. c.* 1891

Pilobolus longipes Van Tieghem, *l. c.* 6, 4: 338. 1876.
Pilobolus roridus Bref. Bot. Unters. 4: 70. 1881.

This species is possibly mistaken for one of the other species and therefore has not been previously reported for America. The long swelling at the base of the sporangiophore and the elliptic-spherical spores are determinative characters.

SUBSTRATA: On horse dung.

SPECIMENS EXAMINED: Pennsylvania, *Sumstine;* New York, *Sumstine.*

ILLUSTRATIONS: Van Tieghem, *l. c. pl. 10, f. 10–15;* Bref. *l. c. pl. 4, f. 17;* Bainier, Étude, *pl. 2, f. 11–12.*

4. HYDROGERA OEDIPUS (Mont.) O. Kuntze, *l. c.* 1891

Pilobolus Oedipus Mont. Mem. Soc. Linn. de Lyons 1. 1826.

(The original description was not seen by me.)

This species may be known by the rather short sporangiophores and the globose spores of unequal size.

SUBSTRATA: On dung of horse.

SPECIMENS EXAMINED: The following collections are in the Herbarium of the New York Botanical Garden but only the ejected sporangia caught on paper and on leaves are found in the packets and therefore the determinations were made from spore characters only.

Canada, *Ellis;* Kansas, *Kellerman;* Louisiana, *Langlois;* Nebraska, *Williams;* Pennsylvania, *Meehan, Rothrock, Scribner.*

ILLUSTRATIONS: Bainier, Étude, *pl. 2, f. 1–10.*

SPECIES REPORTED

Hydrogera rorida O. Kuntze, *l. c.* 1891. *Mucor roridus* Bolt. Hist. Fung. 3: 168. 1789. *Pilobolus roridus* Pers. Syn. Fung. 117. 1801.

This species is reported by Pound in Minn. Bot. Studies 1: 101. 1894.

7. PILAIRA Van Tieghem, Ann. Sci. Nat. VI. 1: 51. 1875

ORIGINAL DESCRIPTION: Les deux caractères que nous venons d'assigner au genre *Pilobolus,* à savoir la déhiscence spéciale du sporange, déterminée par la structure même de cet organe, et sa projection, liée au contraire à la forme et à la structure du filament qui le porte, sont, avons-nous dit, indépendants l'un de l'autre. On concoit donc que le premier puisse exister sans le second, et c'est précisement ce qui a lieu dans le genre nouveau que nous allons étudier maintenant. Le sporange y possède la même structure, et par conséquent le même mode de déhiscen-

ce que chez les *Pilobolus;* mais il n'est pas projeté dans l'atmosphère, et à cette absence de projection correspond naturellement l'absence de la structure et de la forme si caractéristiques du filament sporangifère qui déterminent ce phénomène les *Pilobolus.* . . . C'est de cette faculté de soulever son sporange au lieu de le projeter que j'ai tiré le nom générique *Pilaira,* par opposition à celui de *Pilobolus.*

Type species, *Pilaira Cesatii* Van Tieghem = *Pilobolus anomalus* Cesati.

This genus is chiefly distinguished from *Hydrogera* by the absence of mycelial and subsporangial swellings.

Fischer (Rabenh. Krypt. Fl. 1[4]: 257) cites *Hydrophora tenella* Tode as a synonym of *Pilaira nigrescens* Van Tieghem. If the synonymy of these two species could be established, then the genus *Pilaira* would become a synonym of *Hydrophora* with *H. tenella* as the type of the latter genus. This would change the conception of the genus *Hydrophora.* The lack of type specimens and the very brief diagnosis of *Hydrophora tenella* do not justify such a conclusion. The genus of Van Tieghem therefore stands.

1. PILAIRA FIMETARIA (Link) Pound, Minn. Bot. Studies 1: 100. 1894

Mucor fimetarius Link, Ges. Naturf. Freunde Berl. Mag. 3: 30. 1809. Berl. Mag. Gesell. Naturf. Freunde.
Pilobolus anomalus Cesati, Bot. Zeit. 9: 647. 1851.
Hydrophora fimetaria Fries, Syst. Myc. 3: 313. 1829.
Ascophora Cesatii Coemans, Acad. Roy. Sci. Belg. 30: 63. 1861.
Pilaira Cesatii Van Tieghem, Ann. Sci. Nat. VI. 1: 51. 1875.

Link's name is evidently the oldest that can with any certainty be applied to this species.

The sporangia are black when mature, columella depressed globose, spores oval or elliptic oval. The zygospores are borne on tongue-shaped copulating branches.

SUBSTRATA: On decoction of manure.

SPECIMENS EXAMINED: Pennsylvania, *Sumstine.* (In laboratory cultures.)

ILLUSTRATIONS: Van Tieghem, *l. c. pl. 1, f. 14–24;* Coemans, *l. c. pl. 2, f. e.*

8. SYZYGITES Ehrenb. Syll. Myc. Berol. 25. 1818

Sporodinia Link, Willd. Sp. Pl. 6[1]: 94. 1824.

Type species, *Sporodinia grandis* Link.

? *Azygites* Moug. et Fries; Fries, Syst. Orb. Veg. 1: 364. 1825.

ORIGINAL DESCRIPTION: Hic fungus est verus Mucor erectus, Aspergillo maximo simillimus, simul vero est vera conjugata. Ab Aspergillo recedit vesicis lateralibus binis in corpus fusiforme connascentibus. Moventur semina.

Type species, *Syzygites megalocarpus* Ehrenb.

Sporangiophores erect, septate, repeatedly dichotomously branched, terminated by a sporangium with columella; zygospores on special, upright, dichotomously branched filaments.

Link bases his new genus *Sporodinia* on *Aspergillus globosus* Link (Obs. 1: 14. *f. 15.* 1809). There is no such species given on page 14 but on page 16, figure *15* is cited under the name *Aspergillus maximus*. The figure is very clearly the species under consideration.

The genus *Azygites* is not clear.

1. SYZYGITES ASPERGILLUS (Scop.) Pound, Minn. Bot. Studies 1: 96. 1894

? *Mucor ramosissimus* Haller, Hist. Stirp. Helv. 3: No. 2167. 1768.

Mucor aspergillus Scop. Fl. Carn. 2: 494. 1772.

Mucor ramosus Bull. Hist. Champ. Fr. 116. 1791.

Mucor flavidus, Pers. Obs. Myc. 1: 95. 1796.

Mucor rufus Pers. Syn. Fung. 200. 1801.

Aspergillus maximus Link, *l. c.* 1809.

Syzygites megalocarpus Ehrenb. *l. c.* 1818.

? *Monilia spongiosa* Pers. Myc. Europ. 1: 30. 1822.

Sporodinia grandis Link, *l. c.* 1824.

Mucor capitato-ramosus Schw. Trans. Am. Phil. Soc. II. 4: 285. 1832.

Sporodinia dichotoma Corda, Ic. Fung. 1: 22. 1837.

? *Nematogonium fumosum* Bonord. Hdbk. Allg. Myk. 116. 1851.

? *Nematogonium simplex* Bonord. Hdbk. Allg. Myk. 117. 1851.

Mucor dichotomus Bref. Bot. Unters. 4: 95. 1881.

Sporodinia aspergillus Schroet. Syll. Fung. 7: 207. 1887.

This species has been frequently described by different authors, as the above synonyms indicate. The name *Syzygites* was given to the zygospore-bearing mycelium while the name *Sporodinia* was applied to the part producing the sporangia.

If the identity of Haller's plant were absolutely sure, his name would have to be substituted for the name given above.

This reddish-brown mould is easily recognized and very generally found on decaying *Boleti* and other fungi.

SUBSTRATA: On decaying agarics, *Boleti, Polypori.*

SPECIMENS EXAMINED: Canada, *Anderson 622;* Maryland, *Fung. Columb. 1494;* Massachusetts, *Farlow 1487;* New Jersey, *Ellis 2279;* Pennsylvania, *Sumstine;* Virginia, *Murrill.*

ILLUSTRATIONS: Bull. *l. c. pl. 480, f. 3;* Pers. *l. c. pl. 6, f. 5;* Bref. *l. c. pl. 6, f. 23–25;* Bainier, Étude, *pl. 4, f. 1–10.*

9. CIRCINELLA Van Tieghem & Le Monnier, Ann. Sci. Nat. V. 17: 298. 1872

ORIGINAL DESCRIPTION: Le filament fructifère est recourbé en crosse au-dessous du sporange qui est ainsi réfléchi vers le bas. . . . En outre, le développement de leur appareil fructifère aérien est indéterminé, et, comme les *Rhizopus* et *Chaetocladium,* elles végètent en guirlandes à la manière des Lianes.

Le sporange, ainsi refléchi le long du filament qui le porte, est de forme sphérique, et muni d'une grande columelle cylindro-conique; sa membrane est incrustée de granules d'oxalate de chaux, non diffluente, et à la maturité elle se déchire circulairement vers son milieu, en laissant une large cupule hémisphérique autour de la base de la columelle pour laisser échapper un grand nombre de petites spores sphériques. (In part.)

Type species, *Circinella umbellata* Van Tieghem et Le Monnier.

Sporangiophores growing singly from the mycelium, not terminated by a sporangium, with lateral, fascicled or single, circinate branches terminated by a sporangium with columella; zygospores borne on distinct sporangiferous filaments.

1. CIRCINELLA UMBELLATA Van Tieghem & Le Monnier, *l. c.* 300. 1872

Mucor umbellatus Schroet. Krypt. Fl. Schles. 3: 206. 1886.

The clusters of sporangia on the principal sporangiophores enable one to identify this species.

SUBSTRATA: On dung of lion, horse, jaguar.

SPECIMENS EXAMINED: New York, *Sumstine;* Pennsylvania, *Sumstine.*

ILLUSTRATIONS: Van Tieghem & Le Monnier, *l. c. pl. 21, f. 18–23;* Bainier, Étude, *pl. 6, f. 1–7;* Bainier, Bull. Soc. Myc. Fr. *pl. 7, f. 10.*

10. THAMNIDIUM Link, Ges. Naturf. Freunde Berl. Mag. 3: 31. 1809

ORIGINAL DESCRIPTION: Sporangium globosum. Stipes tubulosus, septatus, basi ramosissimus, ramorum apicibus sporidia nuda sustentantibus. Hoc genere series quae a Mucedinibus incipiebat, iterum ad Mucedines redit. Sporangium mucoris, peridio tenuissimo, aqua adfusa rumpente et sporidia majuscula, globosa effundente.

Stipes Mucedinum basi quoque in ramis dichotomis vera Mucedinum sporidia nuda profert, ita ut revera ambigua sit planta.

Type species, *Thamnidium elegans* Link.

Sporangiophores erect, terminated by a sporangium, with several dichotomously divided branches; the terminal sporangia many spored with columella; sporangioles on the dichotomous branches with few spores and without columella; zygospores formed on the mycelium, naked, copulating branches straight.

1. THAMNIDIUM ELEGANS Link, *l. c.* 1809

Melidium subterraneum Eschweiler, De Fruc. Gen. Rhiz. 33. 1822.

Mucor elegans Fries, Syst. Myc. 3: 322. 1829.

Ascophora elegans Corda, Ic. Fung. 3: 14. 1839.

This beautiful species is easily recognized by the two kinds of sporangia and by the dichotomous branches. It is seldom reported from this country.

Bachmann (Bot. Zeit. 107. 1895) describes six different typical forms cultivated on different substrata.

SUBSTRATA: On dung of tiger and horse.

SPECIMENS EXAMINED: Pennsylvania, *Sumstine.*

ILLUSTRATIONS: Link, *l. c. pl. 2, f. 45;* Eschweiler, *l. c. pl. f. 10;* Corda, *l. c. pl. 2, f. 43;* Bref. Bot. Unters. 9: *pl. 2, f. 1–8;* Bainier, Étude, *pl. 8, f. 1–5;* Nees, Sys. der Pilze, *pl. 6, f. 75.*

11. BULBOTHAMNIDIUM Klein, Verh. Zool.-bot. Ges. Wien **20**: 557. 1870

Chaetostylum Van Tieghem & Le Monnier, Ann. Sc. Nat. V. **17**: 328. 1873.

Type species, *Chaetostylum Fresenii* Van Tieghem & Le Monnier.

ORIGINAL DESCRIPTION: Die aufrechte Fruchthyphe zeigt bei *Bulbothamnidium* unterhalb der Spitze eine unregelmässig kugelige oder ellipsoidische Anschwellung, aus welcher rundherum viele Seitenzweige zweiter Ordnung entspringen, die abermals unter der Spitze eine Anschwellung zeigen, aus welcher erst viele kurze Zweige 3. Ordnung entspringen und die kugeligen Sporangiolen tragen. Ausser dieser Grundform finden sich noch einige Modificationen derselben und zwar kommt es vor, dass die Haupthyphe keine Anschwellung zeigt, sondern dass die Seitenzweige zweiter Ordnung wirtelig als gewöhnliche Verzweigungen entstehen, und sich dann im Uebrigen ebenso verhalten, wie im ersten Fall. Weiter findet man Haupthyphen mit mehreren Anschwellungen über einander, diese aber sind einseitig, aus denselben entspringen wieder viele Seitenzweige zweiter Ordnung, welche unter der Spitze eine allseitige Anschwellung zeigen, aus welcher dann, wie im ersten Fall die kurzen Sporangiolen tragenden Zweige dritter Ordnung ausgehen. Die Anschwellung kann auch an den Aesten zweiter Ordnung nur einseitig sein, wie es in Fig. *17* bei *b* zu sehen ist, während gleich über dieser Stelle noch eine allseitig Anschwellung zu finden ist.

Type species, *Bulbothamnidium elegans* Klein = *Ascophora pulchra* Preuss.

Sporangiophores erect, terminated by a sporangium with columella, with numerous side branches terminated by sterile ends; sporangiferous branches springing from swellings or bulbs, sporangioles without columella; zygospores unknown.

1. **Bulbothamnidium pulchrum** (Preuss).

Mucor Mucedo Fres. Beitr. zur Myk. 96. 1860. (In part.)

Ascophora pulchra Preuss, Linnaea **24**: 139. 1851.

Bulbothamnidium elegans Klein, *l. c.* 1870.

Chaetostylum Fresenii Van Tieghem & Le Monnier, *l. c.* 1873.

Thamnidium chaetocladioides Bref. Bot. Unters. 4: 57, 58. 1881.
Thamnidium Fresenii Schroet. Krypt. Fl. Schles. 3: 210. 1886.

The branches growing from swellings on the principal sporangiophores are very characteristic of the genus and the species. My specimens have longer branches than the measurements given in the various descriptions cited but otherwise they agree.

SUBSTRATA: On decaying *Polyporus* among other moulds.

SPECIMENS EXAMINED: Pennsylvania, *Sumstine.*

ILLUSTRATIONS: Fresenius, *l. c. pl. 12, f. 13–16;* Van Tieghem & Le Monnier, *l. c. pl. 23, f. 61–63;* Brefeld, *l. c. pl. 2, f. 5; idem.* 9: *pl. 2, f. 9–18;* Bainier, Étude, *pl. 7, f. 1–7.*

2. **Bulbothamnidium pulchrum variabile** var. nov.

On a piece of beef kept in a refrigerator at a temperature of 40° Fahr. there appeared a dense growth of mould in the autumn of 1908. A careful examination failed to identify it. The sporangiophores were simple, unbranched, 5–15 mm. high, white to grayish white; sporangia large, gray with a greenish hue, spherical; columella cylindrical with collarette; spores elliptical, 6–12 μ, often larger in the same sporangium. The material was set aside and marked new species.

A year later the same plants growing under similar conditions were again found. From this material cultures were made on sterilized bread. The culture proved very perplexing; instead of a simple sporangiophore, there appeared branched sporangiophores as in *Bulbothamnidium pulchrum.* In all, sixteen cultures were made and exactly the same result was obtained in each culture. Ordinary beef (not sterilized) was then inoculated with spores from the original plants and kept at a temperature of about 40° Fahr. The simple sporangiophores were produced in these cultures.

The mode of branching, the shape and the size of sporangium, columella and spores agree fairly well with *Bulbothamnidium pulchrum* and therefore I do not feel justified at present in describing it as a new species. The variability in the form of the sporangiophores on different substrata and under different conditions seems to merit a new form.

SUBSTRATA: On beef and sterilized bread.

SPECIMENS EXAMINED: Pennsylvania, *Sumstine.*

Diagnosis: Hyphae sporangiferae simplices, non ramosae, erectae, candidae, 5–15 mm. altae; sporangia magna, candida, viridi-flava, sphaerica; columella cylindrica; sporae variae in magnitudine, ellipticae, 6–12 μ.

Hab. In bubula.

12. HELICOSOTYLUM Corda, Icon. Fung. **5**: 18, 55. 1842

ORIGINAL DESCRIPTION: Hyphasma decumbens, ramosum, continuum. Stipes erectus spiraliter incurvatus, simplex, continuus, dein deciduus. Sporangium acrogenum, membranaceum, stipite adfixum dein deciduum, rumpens. Columella nulla. Sporae irregulariter conglobatae continuae, episporio simplici, nucleo firmo, guttulis oleosis repleto.

Type species, *Helicostylum elegans* Corda.

Sporangiophores erect or decumbent, terminated by a sporangium with a columella; branches spirally and irregularly arranged along the sporangiophores, terminated by a sporangium without columella. The zygospores are unknown.

SPECIES REPORTED

1. *Helicostylum cyaneum* Pound and Clements, Bot. Survey Neb. **4**: 5. 1896.

13. CALYPTROMYCES Karst. Bot. Zeit. **20**: 365. 1849

Pleurocystis Bonord. Hdbk. Allgemein. Myk. 124. 1851.

Type species, *Pleurocystis Fresenii* Bonord. = *Mucor racemosus* Fres.

Chlamydomucor Bref. Bot. Unters. **8**: 228. 1890.

Type species, *Mucor racemosus* Fres.

ORIGINAL DESCRIPTION: Peridiola globosa, membranacea, circumscissa, in floccis terminalia, nucleos centrales, persistentes, sporidiaque includentia. Sporidia subglosa discreta. Flocci tubulosi, erecti, septati ramosi vel simplices. Thallus ramosus, vesiculis, farctus vel cellulosus.

Type species, *Calyptromyces ramosus* Karst.

Karsten was the first to establish a separate genus for branching Mucors. Two new species are described under this genus,

Calyptromyces ramosus and *simplex*. The former is well described and figured. He also describes and illustrates the germination of the spores and the chlamydospores.

Bonorden described a genus for short-branched Mucors. Five species are listed under the genus. The first, *Pleurocystis ascendens*, is described and figured as new. This may be an abnormal form of the Karsten species. *Pleurocystis fungicola*, which is the same as *Ascophora fungicola* Corda, is probably referable to *Calyptromyces ramosus*. *Pleurocystis Helicostylum* and *Candelabrum* are placed under other genera. This still leaves *Pleurocystis Fresenii*, which Bonorden says is synonymous with *Mucor racemosus* Fres.

This complex group contains some forty described species but the relationship of these species is not well known. There seem to be two modes of branching, monopodial and sympodial. This branching has been made the basis for the division into two groups, Racemo-Mucor and Cymo-Mucor (see Fischer, *l. c.* and Lendner, *l. c.*). This division, however, is uncertain and unsatisfactory.

A number of the species produce in addition to the zygospores, azygospores. Of the species referred to this genus by European authors 6 produce azygospores, 6 zygospores only and in 29 neither zygospores nor azygospores have been observed. Of the 12 species whose zygospores or azygospores are known, eight belong to the section Racemo-Mucor. Of the 4 remaining species, one is imperfectly described and the branching not definitely known, one is closely allied to the genus *Circinella*, one has zygospores closely resembling azygospores, and one is described as monopodially and sympodially branched.

Vuillemin has established a new genus (see *Zygorhynchus*) for two species of this section. The formation of the zygospores is the basis for the separation.

When the zygosporic or the azygosporic characters of the 29 remaining species are known some of them may be referred to the genus *Calyptromyces*, others to the genus *Zygorhynchus*, and others may have sufficient differences to justify the establishment of a new genus or even new genera.

Cultures in known media will in all probability aid in deter-

mining the line of cleavage between genera as well as between species.

The azygospores indicate a tendency to eliminate the sexual method of reproduction. Investigation along this line may aid in solving some problems in the evolution of plants and possibly determine more clearly the phylogeny of the Mucoraceae.

In more than one half of the species there are also developed oïdiospores and chlamydospores. These may have some taxonomic value when they are more clearly understood.

The limits of this genus are possibly best left undetermined for the present except as defined in the original description. It seems that most of the species listed in Section 2, Racemo-Mucor, by Fischer *l. c.* and Lendner *l. c.* should be placed in this genus.

KEY TO THE SPECIES

Sporangiophores with short, straight or very slightly bent branches. 1. *C. ramosus.*
Sporangiophores with rather short circinate branches. 2. *C. circinelloides.*
Sporangiophores with usually long branches.
Columella globose or nearly so. 3. *C. erectus.*
Columella piriform with spines. 4. *C. plumbeus.*
Columella piriform without spines. 5. *C. globosus.*

1. CALYPTROMYCES RAMOSUS Karst. *l. c.* 1849

? *Mucor juglandis* Link, Ges. Naturf. Freunde Berl. Mag. 3: 30. 1809.
? *Mucor truncorum* Link, Ges. Naturf. Freunde Berl. Mag. 3: 30. 1809.
Mucor racemosus Fres. *l. c.* 1850.
Pleurocystis Fresenii Bonord. *l. c.* 1851.
Chlamydomucor racemosus Bref. *l. c.* 1890.

Link describes two branching Mucors that seem to agree with the species under consideration but it is impossible to say definitely that his plants are identical with Karsten's plants. If these plants are the same then Link's name would have to be substituted for the name given above.

The height of the sporangiophores varies from 5–50 mm. The branches are usually short and straight. The columella may be globose or oval. The spores globose or elliptical. The chlamydospores and oïdiospores are very numerous. Both zygospores and azygospores have been observed.

SUBSTRATA: On bread, mule dung, potato.

SPECIMENS EXAMINED: New York, Pennsylvania, *Sumstine.*

ILLUSTRATIONS: Karst. *l. c. pl. 6;* Fres. *l. c. pl. 1;* Fischer, *l. c. f. 30.*

2. **Calyptromyces circinelloides** (Van Tieghem).

Mucor circinelloides Van Tieghem, Ann. Sci. Nat. VI. **1**: 94. 1875

The branches are circinate but all terminate with a sporangium. This species seems to connect with the genus *Circinella.* Fischer *l. c.* 205 describes the zygospores.

SUBSTRATA: On bread.

SPECIMENS EXAMINED: New York, Pennsylvania, *Sumstine.*

ILLUSTRATIONS: Bainier, *l. c. pl. 7, f. 9–15;* Hagem, Unters. Norweg. Mucor. **1**: 36.

3. **Calyptromyces erectus** (Bainier).

Mucor erectus Bainier, Ann. Sci. Nat. VI. **19**: 207. 1884.

This species differs from the preceding by the longer branches, by the elliptic and unequal spores. Zygospores and azygospores have been observed (see Bainier, *l. c.*).

SUBSTRATA: On ground flaxseed.

SPECIMENS EXAMINED: Pennsylvania, *Sumstine.*

4. **Calyptromyces plumbeus** (Bonord.).

Mucor plumbeus Bonord. Abh. Naturf. Ges. Halle **8**: 109. 1864.

Mucor spinosus Van Tieghem, Ann. Sci. Nat. VI. **4**: 390. 1876.

The spines growing on the top of the columella are very characteristic of this species. The only other species known to have a spinescent columella is *Mucor spinescens* Lendner. The latter differs from the former in the smaller sporangiophores.

SUBSTRATA: On beef broth, bread.

SPECIMENS EXAMINED: Pennsylvania, *Sumstine.*

ILLUSTRATIONS: Fischer, *l. c. f. 30 e;* Bainier, *l. c. pl. 7, f. 1–8.*

5. **Calyptromyces globosus** (Fischer).

Mucor globosus Fischer, *l. c.* 202. 1892.

This species was found by Walter Kerr, a student in the Pittsburgh High School, by exposing boiled potatoes for *Mucor* spores.

The specimens agree very well with Fischer's discription except in the shape of the columella. This is given as piriform but my specimens have variously shaped columellas, piriform, obovate, panduriform. The sporangia are globose, at first greenish-yellow, at maturity brown to black.

SUBSTRATA: On boiled potato, sterilized bread.

SPECIMENS EXAMINED: Pennsylvania, *Kerr, Sumstine.*

SPECIES REPORTED

1. *Mucor ambiguus* Vuillemin, Bull. Soc. Nancy 92. 1886.

This species is reported by Kauffman (Ann. Rep. Mich. Acad. Sci. **8**: 28. 1905). It was found on mummied plums.

14. ZYGORHYNCHUS Vuillemin, Soc. Myc. Fr. **19**: 114, 115, 116. 1903

ORIGINAL DESCRIPTION: Filaments du thalle continus, ramifiés, inégaux, parfois noueux, plongeants, rampants ou formant un-duvet aérien cotonneux. Chlamydospores lisses, intercalaires ou terminales. Pédicelles isolés ou groupés sur des systèmes sympodiques irréguliers qui portent des sporocystes normaux, des sporocystes abortifs et des zygospores. Pas d'apophyse. Sporocystes uniformes, à membrane plus ou moins concrescente avec la base de la columelle, plus ou moins incrustée d'oxalate de calcium, plus ou moins diffluente. Quand la membrane est fugace, elle laisse à la base une collerette. Spores nombreuses, petites lisses. Zygospores fortement hérissées, rostrées. Tympans d'insertion subopposés, inégaux, le plus petit au sommet du rostre. Suspenseurs inégaux et dissemblables, le petit droit et court, le grand long, courbe, termine par un renflement piriforme. Gametes très inégaux. L'appareil zygosporé nait sur un système de filaments aériens, comme les sporocystes.

Type species, *Mucor heterogamus* Vuillemin.

The development of the zygospores from unlike and unequal copulating branches characterizes this genus.

1. ZYGORHYNCHUS MOELLERI Vuillemin, *l. c.* 117. 1903

Mucor Moelleri Lendner, Mucor. Suisse 72, 1908.

The type species of the genus has not been found since its

first discovery in 1886. This second species was found in 1902. It differs principally in the smaller elliptic spores, smaller zygospores, and depressed columella. Azygospores and chlamydospores are rather abundant.

SUBSTRATA: On sterilized bread.

SPECIMENS EXAMINED: Pennsylvania, *Sumstine*. (Only in laboratory cultures.)

ILLUSTRATIONS: Lendner, *l. c. f. 25*.

ADDITIONAL GENERA

The following genera have been established somewhat recently by European authors but no species of these genera have yet been reported for America. An enumeration of these genera may interest students of the American Mucoraceae.

1. *Pirella* Bainier, Ann. Sci. Nat. VI. **15**: 84. 1882.

Type species, *Pirella circinans* Bainier.

The zygospores are unknown. It is very near the genus *Circinella*.

2. *Dicranophora* Schroet. Jahresb. Schles. Ges. Vaterl. Cultur. **64**: 198. 1886. (Not available.)

Type species, *Dicranophora fulva* Schroet.

This species has been found only by Schroeter, on *Paxillus involutus*.

It may be recognized by the principal sporangia with central columella and numerous spores and by the sporangioles on dichotomous branches with forked columella and few spores. The zygospores have very unequal suspensors.

3. *Tieghemella* Berlese & De Toni; Sacc. Syll. Fung. **7**: 215. 1888.

Type species, *Absidia repens* Van Tieghem.

The zygospores are unknown.

4. *Mycocladus* Beauverie, Ann. de Univer. de Lyon 162–180. 1900.

Type species, *Mycocladus verticillatus* Beauverie.

This has been placed by Lendner in the genus *Absidia* although the zygospores do not have the cuticularized threads or filaments.

5. *Proabsidia* Vuillemin, Bull. Soc. Myc. Fr. **19**: 116. 1903.

Type species, *Mucor Saccardoi* Oudemans.

The zygospores have the characters of the genus *Absidia.*

6. *Lichtheimia* Vuillemin, Bull. Soc. Myc. Fr. **19**: 126. 1903.

Type species, *Mucor corymbifer* Cohn.

The zygospores have not been observed.

7. *Parasitella* Bainier, Bull. Soc. Myc. Fr. **19**: 153. 1903.

Type species, *Parasitella simplex* Bainier = *Mucor parasiticus* Bainier.

The specific name has been changed in the transfer to the new genus. The zygospores are not known.

8. *Glomerula* Bainier, Bull. Soc. Myc. Fr. **19**: 154. 1903.

Type species, *Glomerula repens* Bainier.

From the description and figure, this seems very different from the other known Mucors.

9. *Pseudo-Absidia* Bainier, Bull. Soc. Myc. Fr. **19**: 155. 1903.

Type species, *Absidia dubia* Bainier.

The specific name is changed to *Pseudo-Absidia vulgaris* Bainier. This is generally referred to the genus *Absidia.*

THE SCHWEINITZ COLLECTION OF MUCORS

In his Synopsis of North American Fungi, Schweinitz lists under the genus *Mucor* seventeen species, Nos. *2726–2742,* as follows, *Mucor fimetarius, rufus, flavidus, Mucedo, ascophorus, tenuis, carneus, minimus, tenellus, caninus, stercoreus, murinus, Fimbria, albo-virens, truncorum, capitato-ramosus, echinophila;* under *Thamnidium,* one species, No. *2743, Thamnidium elegans;* under *Pilobolus,* two species, Nos. *2227–2228*, *Pilobolus crystallinus, roridus.*

All these numbers are missing in the Herbarium of the Academy of Sciences, Philadelphia, and therefore further consideration is out of the question.

There are some unnumbered packets in this herbarium that belong to the Schweinitz collection. The specimens were presumably collected by him. The following is a list of these specimens with my notes.

1. *Mucor rufus.* No specimen in the packet but the label reads "*Mucor rufus* in *Boleto.*" This was probably *Syzygites aspergillus.*

2. *Mucor minimus.* The name *tenellus* also appears on the

label but has been crossed out. There is nothing on the substratum to indicate the presence of a *Mucor*.

3. *Mucor tenuis*. The packet contains small pieces of discolored wood.

4. *Mucor albo-virens*. No specimen in the packet.

5. *Mucor caninus*. No specimen in the packet but inside the packet is written "*Mucor stercoreus*, Beth., *Aspergillus flavus*, Salem."

6. *Mucor Fimbria*. Packet empty.

7. *Mucor ascophorus*. No specimen in the packet but an additional label reads, "*Ascophora Mucedo*."

8. *Mucor truncorum*. Only a few stems (sporangiophores ?) were found. Impossible to identify.

9. *Mucor capitato-ramosus*. This was a new species. A remnant of the host, possibly a *Polyporus*, was the only thing found in the packet. See under *Syzygites aspergillus*.

10. *Mucor echinophila*. This is also described as a new species. The specimens are all gone and the identity is uncertain. The description is brief and inadequate. See Schweinitz, *l. c.* No. 2742.

11. *Syzygites megalocarpus*. The packet is empty, but in all probability he had *Syzygites aspergillus*.

12. *Phycomyces nitens*. A few sporangiophores clearly indicate this species.

13. *Thamnidium elegans*. Not this species, whatever it is. The material is too scanty for identification.

14. *Pilobolus crystallinus*. The packet contains some dried manure but there is no evidence of this species.

THE BERKELEY AND CURTIS SPECIES

In Grevillea 3: 148–149, the following new species are described from America by Berkeley and Curtis:

1. *Mucor paradoxus*. This plant was collected by Michener in Pennsylvania on decaying *Boletus*. "The Flocci are short, hyaline, the vescicles (sporangia) of two kinds, the larger globose on longer flocci, the smaller obovate but narrow on short pedicels springing from the mycelium."

In Sacc. Syll. Fung. 7: 211, this is placed under the genus

Thamnidium by Berlese and De Toni. From the description, it is impossible to tell where it belongs.

2. *Mucor Cucurbitarum.* This was collected in South Carolina by Ravenel and in New England by Sprague, on decaying gourds and melons. The habitat and the description point to the common *Mucor Mucedo.*

3. *Mucor Beaumontii.* Beaumont collected this species in Alabama on decaying cabbage leaves. The spores are said to be dark purple, otherwise it may be referred to *Mucor Mucedo.*

4. *Mucor curtus.* This was found on decaying muskmelon in South Carolina. The spores are "fusiform with a minute appendage at either end, binucleate, .00057 long, about $\frac{2}{5}$ as much wide." This is surely not a *Mucor.*

5. *Ascophora fusca.* This species was described in the Journal of the Linnaean Society **10**: 363. 1868. It was collected in Cuba on fruit of *Atrocarpus.* The sporangia are described as "*globosis dein collapsis umbraculiformibus.*" The collapsed, umbrella-shaped columella indicates *Mucor Mucedo,* or some species of this genus.

State Lists of Fungi

In addition to the references and citations already made, the following lists of fungi were consulted but specimens of the species enumerated in these lists were not examined by the writer and therefore they are not included in the present paper.

ALABAMA: Underwood and Earle, Preliminary List of Alabama Fungi. 1897.

CALIFORNIA: Harkness and Moore, Catalogue of the Pacific Coast Fungi. 1880.

CUBA: Ramon de la Sagra, Icones Plantarum in Flora Cubana Descriptarum. 1863.

GREENLAND: Rostrup, Fungi Groenlandiae. 1888.

MASSACHUSETTS: Tuckerman and Frost, A Catalogue of Plants growing without cultivation within thirty miles of Amherst College. 1875.—Farlow, Bulletin of the Bussey Institute. 1876.

MAINE: Ricker, A Preliminary List of Maine Fungi. 1902.

NORTH CAROLINA: Curtis, Geological and Natural History Survey of North Carolina. Part 3. Botany. 1867.

OHIO: Kellerman and Werner, Catalogue of Ohio Plants. Geology of Ohio. 1895.

PENNSYLVANIA: Herbst, Fungal Flora of Lehigh Valley. 1899.

WEST VIRGINIA: Millspaugh and Nuttall, Flora of West Virginia. 1896.

HIGH SCHOOL,
PITTSBURGH, PENNSYLVANIA.

A NEW POLYPORE ON INCENSE CEDAR

George Grant Hedgcock

During the past three years the writer has repeatedly searched in California and Oregon for the cause of the "peckiness" or "pin-rot" of the incense cedar, which does great injury to the heartwood of this species, and often affects as high as 100 per cent. of the trees in a given area. The fungus whose description follows was found definitely associated in an apparently causal relation to the disease.

Dr. Hermann von Schrenk described this disease of the incense cedar under the name "pin disease" (Mo. Bot. Gard. Rept. **11**: 45–55, *pl. 2, 4, 5,* June 3, 1899), without giving the cause. He later assigned the cause of the disease to *Polyporus libocedrus* (Science N. S. **16**: 138, 1902), but, in the absence of type specimens and a description, there is no means of knowing whether or not his specimen and those now described belong to the same species.

Polyporus amarus sp. nov.

Pileus soft and spongy when young, becoming hard and chalky when old, ungulate, often spuriously stipitate from knot-holes, frequently large, 5–11 × 10–20 × 6–12 cm.; surface pubescent when young, rimose and chalky when old, at first buff, becoming tan and often blotched with brown when older; margin obtuse, frequently having an outer band of darker brown, often slightly furrowed; context creamy-yellow to tan-colored, usually darker in outer layers when old, bitter to the taste and often resinous near the base, somewhat like *Fomes Laricis* (Jacq.) Murr., 4–8 cm. thick; tubes not stratified, brown within, cylindric, 0.5–3 cm. in length, shorter next the margin, mouths circular or slightly irregular, 1–3 to a mm., yellow or yellow-green during growth, turning brown when bruised or old, becoming lacerate; spores hyaline or slightly tinged with brown, smooth, ovoid, 3–4 × 5–8 μ, nucleated; cystidia none.

Type locality: East slope of Marble Mt., Klamath National Forest, California. Specimens collected October 14, 1909; other specimens collected near Dunsmuir, Calif., October 16, 1907.

HABITAT: Living trunks of *Libocedrus decurrens*, causing the pin-rot or peckiness of the heartwood of these trees.

DISTRIBUTION: California and Oregon.

Type specimens are deposited in the pathological herbarium, Bureau of Plant Industry, United States Department of Agriculture, Washington, D. C.

TIMBER AND FOREST DISEASE SURVEY,
WASHINGTON, D. C.

NEWS AND NOTES

Dr. E. J. Durand, instructor in botany at Cornell University, has been appointed assistant professor of botany in the University of Missouri.

Professor G. F. Atkinson, of Cornell University, visited the Garden April 21, to consult some of the older mycological literature.

Dr. George G. Hedgcock, of the National Timber and Forest Disease Survey, spent ten days at the Garden in April, consulting the collections of timber-destroying fungi.

The chair of botany at the University of Vermont has been filled by Dr. George P. Burns, of the University of Michigan.

Dr. Perley Spaulding, of the division of Forest Pathology at Washington, made the Garden a brief visit in April to examine the collection of plant rusts.

Mr. Frank Dunn Kern, associate botanist of the Agricultural Experiment Station at Lafayette, Indiana, has been appointed fellow in botany at Columbia University for the ensuing collegiate year.

Miss E. C. Field, scientific assistant in the Bureau of Plant Industry, Washington, D. C., was at the Garden nearly two weeks in April, consulting the collections of parasitic fungi.

A scientific expedition to Colombia is being organized at Neuchâtel, the leader being Dr. O. Fuhrman, professor of zoology at Neuchâtel University. Dr. Mayor will accompany the expedition and devote his attention mainly to the parasitic flora.

Several specimens of *Pluteus cervinus* were found April 9, growing in a sawdust pile not far from Bronx Park, New York City. The only other fleshy fungi noticed were *Coprinus micaceus,* which is usually the first to appear in quantity in the spring, and the common winter species, *Collybia velutipes*. All of these species are described and figured in the first volume of this journal.

Owing to the excellent series of specimens of *Pyropolyporus praerimosus* Murrill recently collected by Dr. George G. Hedgcock and his assistants on various species of oak and walnut in Texas, Arizona, and New Mexico, it is now possible to connect this species with *Pyropolyporus Everhartii* (Ellis & Gall.) Murrill as a variety of the latter; the very rimose character being probably due to desiccation, as is the case with western forms of *P. igniarius,* particularly the one found commonly on aspen. It often happens that more complete collections will connect species that at first appear both morphologically and geographically distinct.

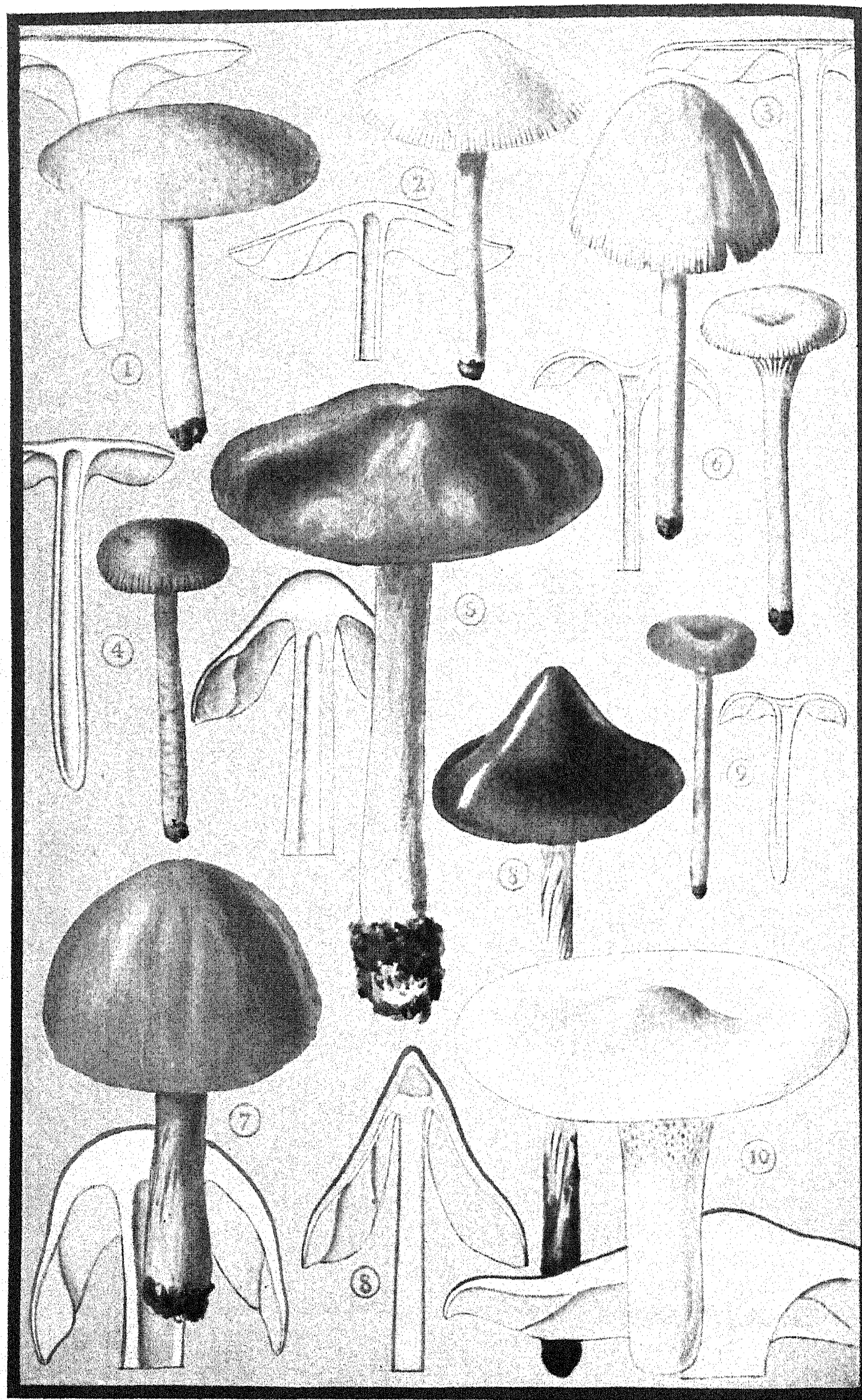
"*Resolved,* That the American Phytopathological Society views with alarm the recent introduction into America of two dangerous European plant diseases: The potato wart, caused by *Chrysophlyotis endobiotica* Schilb., and the blister rust of white pine, caused by *Peridermium strobi* Klebahn. The former has been discovered in Newfoundland. The latter has been widely distributed in nine of the United States and in the Province of Ontario, but is now believed to have been eradicated.

"*Resolved,* that the society deplores the fact that, in the absence of any national regulation in either the United States or Canada, both governments are powerless to prevent the continued introduction of these and other dangerous diseases, or their transference from one country to the other.

"*Resolved,* that on account of the enormous financial interests involved in potato culture and in white pine reforestation, this society regards the situation as very alarming, and one which warrants radical and immediate action. Even if these diseases do no more harm in America than they have in Europe, the situation is serious; but every law of biology and all experiences with plant diseases and pests indicates that, in a new climate, with new varietal and specific hosts, and with an entire continent in which to spread, both diseases will reach a degree of virulence unknown in Europe.

"Therefore, *Resolved,* that this society pledges its support to all legislation in both the United States and Canada looking toward the inspection, quarantine or prohibition from entry, as may be necessary, of all plant material liable to introduce these or other dangerous diseases or pests."

(Signed) F. L. STEVENS,
President.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MYCOLOGIA

VOL. II JULY, 1910 NO. 4

ILLUSTRATIONS OF FUNGI—VII

WILLIAM A. MURRILL

The accompanying plate represents ten of the more common species of *Hygrophorus* found in the United States. The figures are drawn from the studies of Mr. George E. Morris, based upon the publications of Dr. C. H. Peck, State Botanist of New York, whose excellent monograph of the New York species appeared in his report for 1906.

The genus as ordinarily accepted is characterized by a waxy hymenium; the species are fleshy, terrestrial, often brilliantly colored, and many of them are noted for their viscidity. None of them are known to be poisonous; but some species have not yet been thoroughly investigated. Most of them are either too rare or too small to be of importance as food.

Hygrophorus pratensis (Pers.) Fries

MEADOW HYGROPHORUS

Plate 27. Figure 1. $\times \frac{3}{4}$

Pileus firm, convex to expanded, often turbinate, 2–5 cm. broad; surface glabrous, not viscid, buff, tawny, white, or grayish; flesh thick, firm, white, edible, of delicate flavor; gills long-decurrent, thick, distant, often interveined, white or yellowish; spores subglobose to ellipsoid, hyaline, $6\text{–}8 \times 5\text{–}6\,\mu$; stem short, smooth, equal or tapering downward, solid or stuffed, white or subconcolorous, $3\text{–}5 \times 1$ cm.

This variable species is common in late summer in woods and

[MYCOLOGIA for May, 1910 (2: 99–158), was issued June 9, 1910]

pastures throughout the United States and Europe. It represents quite a different type from the bright-colored, viscid, hollow-stemmed species here figured, and was set apart by Karsten with several of its close relatives in a distinct genus.

Hygrophorus ceraceus (Wulf.) Fries

WAXY HYGROPHORUS

Plate 27. Figure 2. × 3/4

Pileus thin, fragile, convex to plane, obtuse, 1–3 cm. broad; surface viscid, striatulate, pale-yellow, the color of wax; flesh concolorous; gills adnate or slightly decurrent, distant, very broad, concolorous; spores ellipsoid, hyaline, 7–8 × 4–5 μ; stem usually equal, straight, rarely flexuous, shining, concolorous, hollow, 3–8 × 0.3–0.5 cm.

This species is small, and yellow throughout, growing in groups among mosses or grasses. It is reported from Greenland to North Carolina and west to Minnesota and Ohio, and also occurs in Europe.

Hygrophorus chlorophanus Fries

SULFUR-COLORED HYGROPHORUS

Plate 27. Figure 3. × 3/4

Pileus thin, fragile, convex to nearly plane, obtuse, striate and often lobed or split at the margin, 2–4 cm. broad; surface pale-yellow, rarely reddish at the center, glabrous, viscid; flesh thin, yellowish, edible; gills thin, fragile, adnexed, subdistant, ventricose, concolorous or paler; spores ovoid, hyaline, 7–8 × 4–5 μ; stem cylindric, glabrous, viscid, concolorous, hollow, 3–7 × 0.2–0.4 cm.

This species occurs commonly in damp woods from Maine to Alabama and west to Wisconsin; also in Europe.

Hygrophorus psittacinus (Schaeff.) Fries

PARROT HYGROPHORUS

Plate 27. Figure 4. × 3/4

Pileus thin, convex to expanded, umbonate, striatulate on the margin, 1–3 cm. broad; surface smooth, reddish or yellow,

covered with evanescent, greenish slime; flesh white, very thin; gills adnate-decurrent, thick, broad, ventricose, yellow, tinged with green; spores ellipsoid, hyaline, $7–8 \times 5–6\,\mu$; stem cylindric, subequal, tough, viscid, concolorous, $2.5–4 \times 0.3–0.4$ cm.

This very striking species occurs rather rarely in pastures and open woods in the eastern United States from New England to North Carolina, and also in Europe. Its brilliant colors and the greenish slime which envelops it make it conspicuous and easily recognized. Dried specimens fade to pale-orange or yellow.

Hygrophorus puniceus Fries

RED HYGROPHORUS

Plate 27. Figure 5. $\times \frac{3}{4}$

Pileus fragile, conic to subexpanded, obtuse or slightly depressed, 3–10 cm. broad; surface glabrous, viscid, not striate, scarlet, fading out with age, especially at the center; flesh white, tinged with red beneath the cuticle, mild and edible; gills slightly adnexed, broad, thick, distant, yellow, often becoming reddish; spores ellipsoid, hyaline, $8–10 \times 4–5\,\mu$; stem stout, subequal, glabrous, slightly striate, concolorous or paler, white at the base, hollow, $5–8 \times 1–2$ cm.

This is our largest red species of the genus. It occurs sparingly in moist woods in New York and New England, as well as in Europe, and has also been reported from Ohio and California. It is edible and very tender, although too rare to be considered for food.

Hygrophorus nitidus Berk. & Curt.

SHINING HYGROPHORUS

Plate 27. Figure 6. $\times \frac{3}{4}$

Pileus thin, fragile, convex, umbilicate, 1–2.5 cm. broad; surface viscid, striatulate on the margin when moist, pale-yellow, whitish when dry; flesh thin, pale-yellow; gills arcuate-decurrent, distant, interveined, pale-yellow; spores broadly ellipsoid, hyaline, $6–8 \times 5–6\,\mu$; stem slender, fragile, viscid, concolorous, hollow, $7–10 \times 0.2–0.4$ cm.

This small, yellow species occurs in groups or clusters in wet places during late summer. Although edible, it is too small to

collect for food. It is reported from New England to Alabama and west to Minnesota, but it may have been confused with some forms of *Hygrophorus Cantharellus,* which it much resembles.

Hygrophorus coccineus (Schaeff.) Fries

SCARLET HYGROPHORUS

Plate 27. Figure 7. $\times \frac{3}{4}$

Pileus thin, fragile, convex to plane, obtuse, 2–5 cm. broad; surface glabrous, viscid, scarlet, fading to pale-red, and finally yellowish; flesh whitish or yellowish, edible; gills adnate or with a decurrent tooth, distant, interveined, pale-yellow or reddish; spores ellipsoid, hyaline, $6\text{–}8 \times 4\text{–}5\,\mu$; stem cylindric or compressed, glabrous, hollow, scarlet above, yellow below, $3\text{–}5 \times 0.3$ cm.

This brilliantly colored species occurs in moist pastures and on mossy banks in Europe and eastern North America, having been reported from Greenland to North Carolina and west as far as Minnesota.

Hygrophorus conicus (Scop.) Fries

CONIC HYGROPHORUS

Plate 27. Figure 8. $\times \frac{3}{4}$

Pileus thin, fragile, conic, usually acute, often lobed at the margin, 2–4 cm. broad; surface viscid when moist, glabrous or fibrillose, sometimes becoming rimose, some shade of red or yellow, at times tinged with green, almost always turning black on drying; flesh thin, suffused with rosy hues; gills almost free, attenuate behind, thin, rather crowded, ventricose, yellow, blackening on drying; spores ellipsoid, hyaline, $9\text{–}11 \times 6\text{–}8\,\mu$; stem equal, fibrous-striate, hollow, yellow, becoming black on drying, $3\text{–}10 \times 0.3\text{–}0.7$ cm.

This species is usually readily distinguished by its conic cap with acute apex, as well as by its change of color to black on drying. It is common in moist woods and grassy places from Greenland to the Bahamas, and also occurs in Europe.

Hygrophorus miniatus Fries

VERMILION HYGROPHORUS

Plate 27. Figure 9. $\times \frac{3}{4}$

Pileus fragile, regular, convex to plane or umbilicate, 1–5 cm. broad, surface glabrous or minutely squamulose, hardly viscid, scarlet, rarely yellow, soon fading; flesh yellow, mild, tender, edible; gills adnate or very slightly decurrent, distant, yellow often tinged with red; spores ellipsoid, hyaline, $8\text{–}9 \times 4\text{–}6\,\mu$; stem slender, equal, glabrous, concolorous or slightly paler, stuffed or partly hollow, $2\text{–}7 \times 0.2\text{–}0.4$ cm.

This species is very variable in color, size, and mode of growth. It may be looked for in damp woods or swamps, and is readily noticed because of its brilliant coloring. Specimens always fade to yellow on drying.

Hygrophorus Laurae Morgan

LAURA'S HYGROPHORUS

Plate 27. Figure 10. $\times \frac{3}{4}$

Pileus convex to expanded, unbonate, 5–10 cm. broad; surface viscid, white, tinged with red or brown, especially on the umbo; flesh white, edible; gills white, distant, adnate or decurrent, unequal; spores ellipsoid, hyaline, $8\text{–}9 \times 5\text{–}6\,\mu$; stem solid, white within, more or less curved, attenuate below, yellowish-white, scabrous above, $5\text{–}10 \times 0.5\text{–}1$ cm.

This species was originally described from Ohio by Morgan, but has since been found as far west as Kansas and as far east as Massachusetts, growing rather commonly in woods and groves during late summer and autumn. It represents a group of species distinguished from all the rest by a viscid, universal veil, which remains as an annulus or in the form of squamules at the apex of the stem. In the division of Fries' genus *Hygrophorus*, his name remains with this group and an older name, *Hydrophorus* Batt., is used for the viscid, hollow-stemmed species not furnished with a veil.

AN IMPORTANT ENTOMOGENOUS FUNGUS

H. S. Fawcett

(With Plates 28 and 29, Containing 7 Figures)

In 1896, H. J. Webber discovered a fungus parasite of the citrus whitefly and described its sterile form under the name of "Brown mealy-wing fungus (2)." It is now popularly known by the orange growers of Florida as the "Brown fungus" of the whitefly. The spread of this fungus on whitefly larvae,—(1) by means of superficial hyphae that spread over the surface of the leaves attacking every whitefly larva in their way, and (2) by means of spore-like aggregations of cells that may be carried in the air or by insects,—make this fungus one of the most important parasites of the whitefly! This fungus and the red fungus (*Aschersonia Aleyrodis*) are being introduced by orange growers into many localities in Florida with the belief that they are the most economic means yet discovered of keeping the whitefly (*Aleyrodis Citri*) under control.

Spread of the Fungus by Artificial Means

Artificial means of spreading this fungus and *Aschersonia Aleyrodis* have been developed by E. W. Berger, of the Florida Agricultural Experiment Station (12, 13). The two most commonly used are the leaf-pinning method and the spore-spraying method; the first consisting in pinning into a citrus tree fungus-bearing leaves in contact with larva-infested leaves; the second in spraying surfaces of leaves with water contaning the spores of the fungi. The latter method has been taken up quite extensively in some orange groves. This is shown by the fact that at the present time there are men in Florida who make it a regular business to spray whitefly-infested orange trees in this way, getting their supplies of fungus spores from citrus leaves on which the fungus has previously developed upon whitefly larvae. Whenever the atmospheric conditions are favorable to

the growth of these fungi, fair success in checking the whitefly has been attained.

DEVELOPMENT OF THE FUNGUS

The fungus as it develops upon a larva of the whitefly forms a chocolate-brown (No. 10, Saccardo's Chromotaxia) stroma (*pl. 28, f. 2*), which to the unpracticed eye looks like the citrus red scale (*Chrysomphalis Aonidum*). A good description is given of this stage of the development of the fungus by Webber (2) as follows: "The hyphae develop in the body of the insect, burst out around the edges of the scale, and gradually grow up over it. In the early stage they form a brown, compact layer around the edge of the larva. As the fungus develops, the hyphae entirely cover the larval scale, forming a dense, hard, and smooth stroma. The mature stroma is compressed-hemispherical, frequently having a slight depression in the apex over the center of the insect, where the hyphae come together as they spread from the edge of the scale in their development. The hyphae which make up the body of the stroma, are light brown, very tortuous, and but slightly branched. Those in the body of the insect are of similar character, but a much darker brown. From the base of the stroma a ground mycelium, or hypothallus, spreads out in all directions on the surface of the leaf, forming a compact membrane near the stroma, but becoming gradually dispersed into separate filaments." In the later development of the fungus, the separate filamants spoken of by Webber as spreading for a distance of one half inch, grow out over the entire surface of the leaf, branching only sparingly and infecting every larva present. They extend also around the edges and over the upper surface of the leaf. These filamentous hyphae are colorless to slightly tawny with age. They are only occasionally branched, forming a loose, inconspicuous mycelium over the surface of the leaf. On the upper surface of the leaf, on short lateral hyphae, are borne the sporodochia, which are 60 to 90 μ in diameter. These consist of an aggregation of conidia-like, inflated, spherical cells, 12–18 μ in diameter. From near the place of attachment of the sporodochium, there radiate 3 to 5 hypha-like appendages, which are 150–200 μ long by 6–8 μ wide, and are one- to three-septate (*pl.*

29, f. 5). This entire aggregation of spherical cells and appendages usually remains in union and functions as a spore. When abundant, these sporodochia present to the eye the appearance of a reddish-brown dust over the upper surface of the leaf (*pl. 28, f. 1*). The presence of the brown stromata may easily be known at a distance of 10 to 20 feet by this characteristic appearance. In most cases these sporodochia are found only on the upper surface, but if the lower surface of a leaf happens to be turned over for some time they will develop there also. This condition of the fungus is common in the summer and fall. The sporodochia were first noticed in the fall of 1905, and have been observed since in great abundance every year. The supposed connection of these sporodochia with the brown stromata was touched upon in 1908 (15), but only recently has the connection between the two been proved. The relation of the sporodochia to the spread of the fungus is interesting. When mature, the sporodochium with its accompanying appendages breaks off from the mycelium and remains upon the surface, apparently held lightly by the appendages. The inflated cells make it light, so that when once detached it blows about easily, and on coming in contact with a fairly rough surface it tends to hold fast to it. It seems probable that the appendages may also serve to hold the sporodochia to bodies of large insects that may drag them from one part of the tree to another.

Germination of Sporodochia

These *Aegerita* sporodochia when germinated in hanging-drop cultures of sterile water and in 5 per cent. glucose solution, were seen to produce hyphae (*pl. 28, f. 3, 4*) identical with those which compose the brown stromata on the whitefly larvae. When germinating, the first hyphae grow out either from the sporodochia or from the ends of the appendages. These branch rather sparingly, but in a few days, in 5 per cent. glucose solution, form a network by the intercrossing of the branches (*pl. 28, f. 4*).

Inoculations of Whitefly Larvae

Four different attempts were made to inoculate larvae of whitefly with these sporodochia, three of which were successful. One

of these is here given in detail. The sporodochia were carefully picked off one by one under the compound microscope. A camel's hair brush moistened with water containing these sporodochia was drawn over whitefly-infested leaves on trees at Gainesville, Fla., August 11, 1909. No brown fungus could be found nearer than one and one half miles from this place. In 9 days, the young larvae showed effects of fungus infection. In 16 days, the initial stage of the stromata were evident, bursting through the edges of the larvae (*pl. 29, f. 7*). In a few weeks, the typical brown stromata were produced, but no sporodochia were yet evident. In two or three months, the hyphae had grown around to the upper surface of the leaves and had produced the *Aegerita* sporodochia. On more than a hundred trees not inoculated no brown fungus developed.

Because of the economic importance of this fungus, it has been suggested in Science that it be designated as *Aegerita Webberi* for convenience until the perfect stage is found. The form of the hyphae strongly suggest relationship to the Hypochnaceae of the basidiomycetous fungi, but as yet the basidia spores have not been found. A technical description follows.

Aegerita Webberi sp. nov.

Sporodochia superficial, subglobose, whitish when young, turning to reddish-brown when mature, 60–90 μ in diameter, bearing three to five appendages; conidia-like cells globose to ellipsoid, hyaline, inflated, thin-walled, 12–18 μ in diameter, persistent, hanging together in chains and clusters; appendages 3 to 5 in number, straight, thick-walled, 2- to 3-septate, rounded at apex, 150–200 μ long by 6–8 μ at the base, narrowing to 4–6 μ near the apex, arising from within near the base of the sporodochium. Fertile hyphae spreading, colorless to slightly tawny with age, sparingly branched, distantly septate, forming a loose mycelium on the upper surface of the leaf. Stromata pustular, chocolate-brown, smooth, with depressed top when young, becoming convex to flat when mature, 0.5–2 mm. in diameter, composed of intercrossing thick-walled hyphae; margin of stroma membranous, gray to tawny, extending 5–15 mm. and giving rise to a wide-spreading mycelium.

Found on larvae of *Aleyrodes Citri* R. & H. and on *A. nubifera* Berger, on the under surface of citrus leaves.

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GAINESVILLE, FLA.

EXPLANATION OF PLATES XXVIII AND XXIX

FIG. 1. Sporodochia of *Aegerita Webberi* on upper side of an orange leaf. $\times \frac{3}{2}$.

FIG. 2. Brown stromata of *Aegerita Webberi* on lower side of same leaf indicating position of the whitefly larvae that have been parasitized. The three pustules that show white in the figure are of *Aschersonia Aleyrodis* Webber. $\times \frac{3}{2}$.

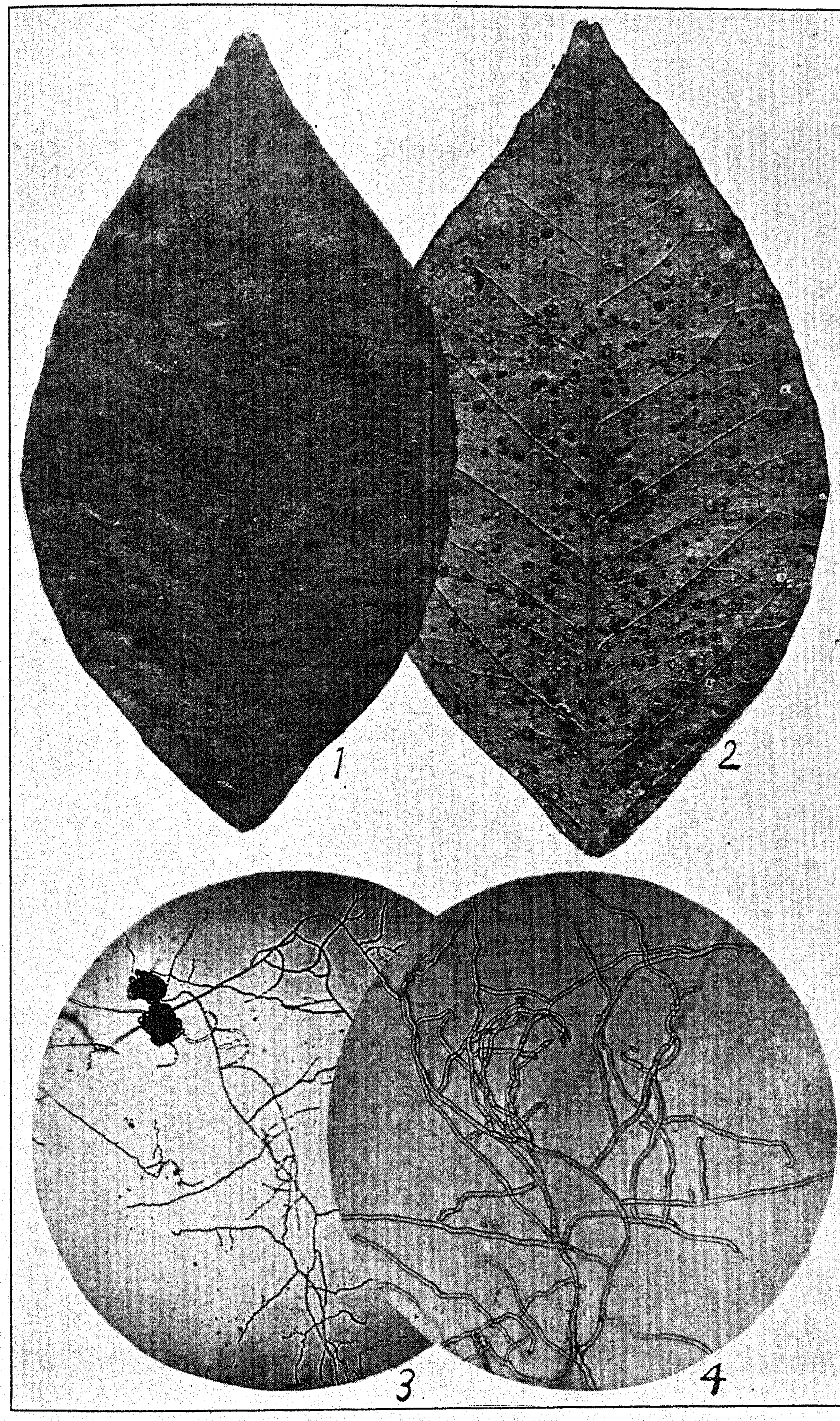
FIG. 3. Two sporodochia of *Aegerita Webberi* germinated in 5 per cent. glucose solution showing growth of mycelium. $\times$ 75.

FIG. 4. Portion of a mycelium in a hanging-drop culture more highly magnified, showing the intercrossing of the hyphae. $\times$ 150.

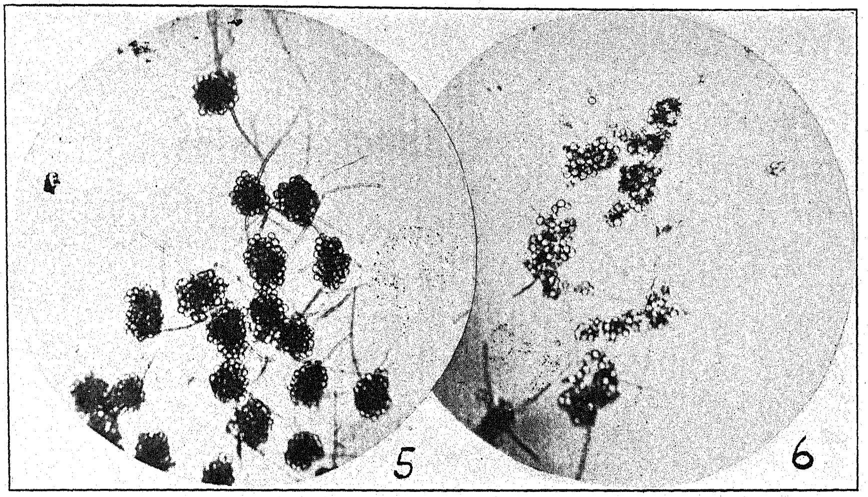
FIG. 5. Sporodochia of *Aegerita Webberi* mounted in water showing conidia-like cells and appendages. $\times$ 80.

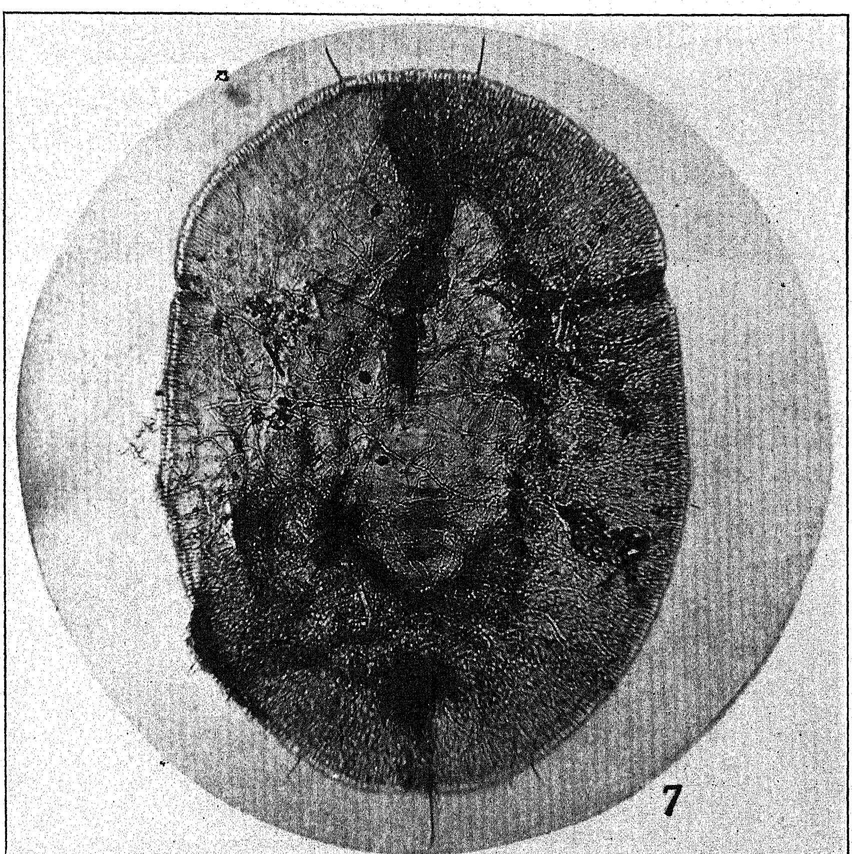
FIG. 6. Same sporodochia broken up under a cover glass to show the clusters and chains of cells. $\times$ 80.

FIG. 7. Larva of *Aleyrodes Citri* parasitized by inoculation with sporodochia of *Aegerita Webberi.* Near the middle and toward one side, the mycelium of the fungus may be seen very clearly.



AEGERITA WEBBERI FAWCETT





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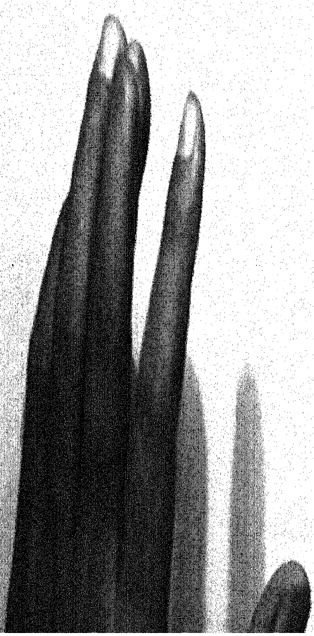


TROCHILA POPULORUM DESM.

C. W. Edgerton

In a recent article, Potebnia* has called attention to the probable connection between *Marssonia Castagnei* (Desm. and Mont.) Sacc., a common fungus on certain species of *Populus,* and the discomycete, *Trochila Populorum* Desm. This connection had previously been suggested to him by Jaap. However, Potebnia is of the opinion that the discomycete is a *Pseudopeziza* rather than a *Trochila.* He arrived at this latter conclusion mostly from the similarity of artificial cultures obtained from *Marssonia Castagnei* spores, to cultures obtained from *Pseudopeziza Salicis,* the perfect stage of *Gloeosporium Salicis.* His material of the perfect stage of the *Populus* fungus was too scanty to be studied.

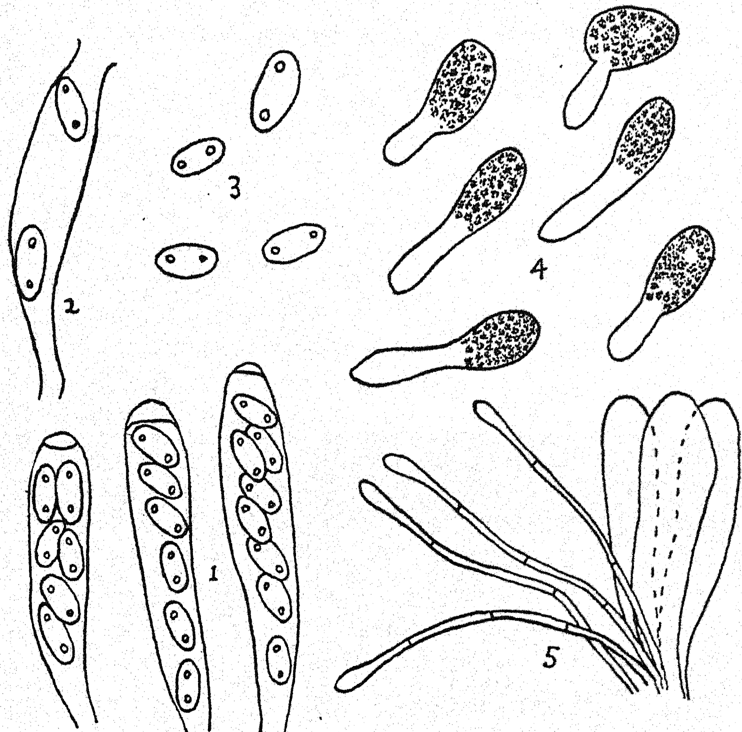
During the past three years, I have had this fungus under observation, trying to connect the *Marssonia* stage with the perfect form. While the study is not complete, and the connection between the *Marssonia* and the *Trochila* is not absolutely proven, it is impossible to carry on the study further on account of being out of the region where the fungus grows, and it is thought best to publish the observations as far as made.

The study of the poplar *Marssonia* was commenced in the summer of 1907, at Ithaca, New York. The fungus is very common in that region on *Populus alba,* forming numerous small dead spots on the leaves. The acervuli develop in abundance on the upper side of the spots. Two sorts of conidia develop in the spots, the large two-celled spores typical of *Marssonia,* and some small, somewhat cylindric to ellipsoid, one-celled spores. The small spores have since been found by Potebnia and are illustrated in his article.

Pure cultures were obtained from the *Marssonia* spores on sterilized bean pods in tubes. The fungus grew slowly, forming a very much localized growth, with the development after some time of the typical *Marssonia* spores.

* Potebnia, A. Beiträge zur Micromycetenflora Mittel-Russlands. Ann. Myc. 8: 79–81. 1910.

In the autumn of 1907, diseased leaves were enclosed in wire nets and placed out of doors to winter. Being located in Louisiana in the spring of 1908, Mr. C. J. Humphrey, of the Botanical Department of Cornell University, kindly sent me the leaves from the nets, and also others picked up from under the affected white poplar trees. The leaves were received during the last part of



FIGS. 1–5. Asci, spores, and paraphyses of *Trochila Populorum*. × 750. 1. Mature asci. 2. An ascus, showing how the apex is ruptured when the spores are thrown out. 3. Ascospores. 4. Germinating ascospores. 5. Paraphyses and young asci.

April and May. In nearly all of the spots on nearly all of the leaves, there was an abundant development of an ascomycete which I determined as *Trochila Populorum*. Many attempts were made to culture the ascospores in 1908, but without success. The spores would not grow in acid media, and, in dilution cultures using ordinary media, bacteria and molds ruined the plates.

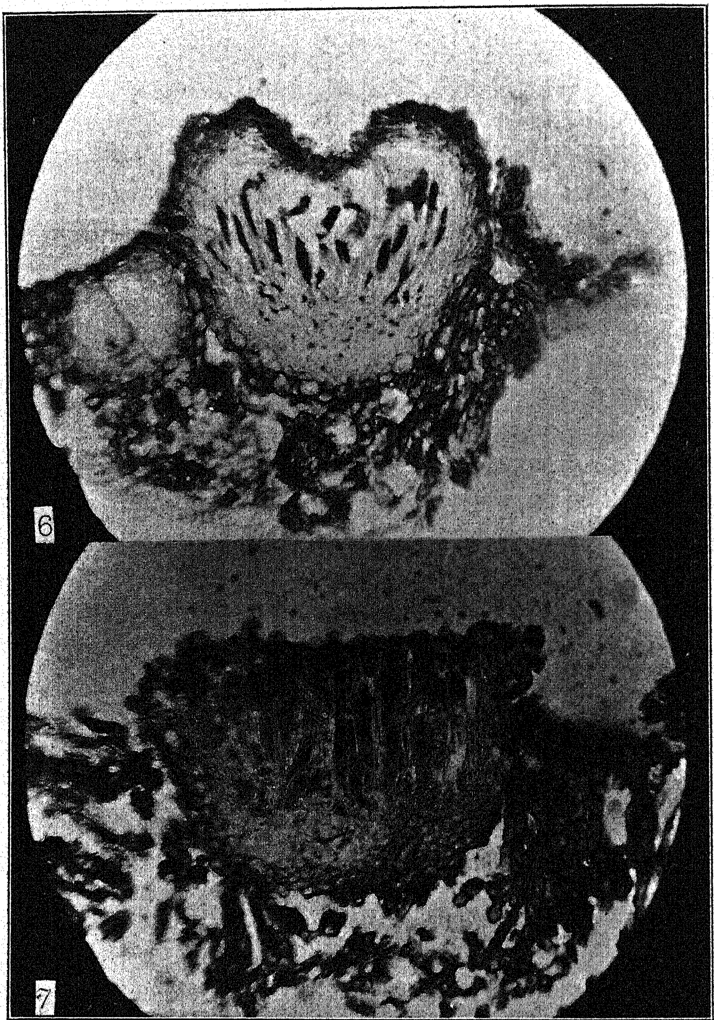
In the season of 1909, material was again sent me from Ithaca, and further attempts were made to culture the spores, though by a different method. The affected leaves were placed in a moist chamber and petri dishes containing sterile agar were inverted over them. As the apothecia opened up, the spores were shot out of the asci into the agar above. These spores germinated and I was able to transfer them to tubes. The germ-tube was sent out either from the side or at the end of the spore (*fig. 4*).

On sterilized bean pods and alfalfa stems, the fungus grew very slowly, finally forming a colony from one to two millimeters in diameter, when all growth ceased. The tubes were kept for nearly a year, some of them being transferred to see if further growth could be obtained. The cultures were examined occasionally, but I was never able to find any two-celled spores in them, being similar in this respect to Potebnia's cultures from the *Marssonia* spores themselves. As the cultures were made in Louisiana, perhaps the high temperature had much to do with the lack of development of the spores. Not being able to find the spores in the cultures, I was not able to prove absolutely the connection between the *Marssonia* and the *Trochila;* but from the fact that the *Trochila* always developed in the *Marssonia* spots, and also from the somewhat similar colonies in pure culture, with the exception of spore formation, it seems very probable that the two forms are connected.

In a letter from Dr. E. J. Durand, he states that *Trochila Populorum* has never been found in America, so far as he knows. This being the case, perhaps a short description may not be out of place.

The apothecia are at first somewhat globose, but as they grow older they generally become more or less flattened and concave at the top (*fig. 6*). The upper portion of the apothecium is forced out of the leaf during its growth, so that at maturity it projects some little distance from the surface of the leaf. The outer layer of the apothecium is composed of a pseudo-parenchymatous tissue of a dark-brown color. Inside of this, there is a more delicate layer of hyaline cells. The outer layer entirely surrounds the developing asci and paraphyses and is not broken apart at the top until the ascospores are nearly mature. In size, the apothecia

are about 90–140 × 100–190 μ. The asci are clavate, 12–14 × 60–80 μ, with the ascus wall thickened at the apex (*fig. 1*). This thickened apex is ruptured when the spores are shot out (*fig. 2*).



FIGS. 6, 7. Apothecia of *Trochila Populorum*. × 330. 6. Young stage. 7. Nearly mature stage.

The spores are hyaline, one-celled, 12–16 × 5–7.2 μ, almost always containing two large guttulae, one at each end of the spore. The paraphyses are very abundant, 80–100, long, narrow, septate, and somewhat broadened at the apex.

It is possible that Potebnia is correct when he believes that this fungus should be placed in the genus *Pseudopeziza*, but, with the present classification, the dark outer layer of cells of the apothecia would cause it to remain in the genus *Trochila*.

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OCCURRENCE OF MONASCUS BARKERI IN BOTTLED PICKLES

Charles E. Lewis

In December, 1909, a white growth of fungous mycelium was observed in a bottle of pickles which had been purchased in Portland, Maine, but which came originally from a Chicago firm. The unopened bottle was placed on a shelf in the laboratory and its examination was neglected until March, 1910. At that time, the upper half of the pickles was covered with mycelium almost pure-white in color.

Some of the material was examined with a microscope and it was found that there were large numbers of fruit-bodies like those of *Monascus*. The writer is familiar with the appearance of both *Monascus Barkeri* Dangeard and *Monascus purpureus* Went, having grown these fungi in cultures for about three years. Plate cultures were made from some of the material from the pickles and the fungus which developed agreed in its characters with *M. Barkeri*. The fungus from the pickles and my cultures of *M. Barkeri*, which were secured originally from the Association Internationale des Botanistes, have been grown on the same culture media under the same conditions for two months and they appear to be identical.

The occurrence of this fungus in a bottle of pickles from Chicago is of interest because the fungus was first described from material from eastern Asia, and, so far as the writer is aware, it has never been reported as occurring in America.

The spores of *Monascus* retain their viability for long periods of time, even when dry, so its occurrence in bottled pickles in this country is probably explained by assuming that the fungus was carried by some of the spices which were used.

Agricultural Experiment Station,
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NOTES ON NORTH AMERICAN HYPOCREALES—III. TWO NEW SPECIES WITH STUDIES OF THEIR LIFE HISTORIES

Fred J. Seaver

(With Plate 30, Containing 13 Figures)

So little is known of the life histories of the polymorphic species of the present order that any information which can be gained as to the complementary phases where the ascigerous stage is known is of much interest to mycologists. Not only is this true because of the fact that it gives us the knowledge of the life history of the individual species studied, but it furnishes at least a clue as to the direction in which to look for the complementary stages in other species where only the perfect or imperfect stages are known.

In my own studies of the Hypocreales, I have been much interested in the group of so-called imperfect fungi known as the Verticillieae and their perfect stages, several of which have been noted among nectriaceous plants. The Verticillieae are characterized by the verticillately branching conidiophores, the plants resembling in this respect *Penicillium*. The conidia are hyaline and borne either singly or in chains. The conidiophores often spring from a more or less well-developed stromatic base, giving the whole a floccose appearance of a whitish or pinkish color.

Among the Nectriaceae, the first species studied which was found to be associated with a *Verticillium* was *Creonectria ochroleuca* (Schw.) Seaver. This species has proved to be very common and a number of synonyms have been worked out. The examination of the types or cotypes of several of these synonyms has shown them to be associated with a *Verticillium*. Spegazzini seems to have been the first to call attention to the association of this *Nectria* with a *Verticillium* in his description of *Nectria vulgaris* Speg., which species is a synonym of the above. The

conidial stage of this species was also described as *Verticillium tuberculoides* Speg.

Creonectria seminicola Seaver, which, as stated in a previous paper, is closely related to the above, has also a *Verticillium* as its conidial stage.

Nectria Bainii Massee, which occurs an cacao pods in the West Indies, is also associated with a *Verticillium.* Our conclusion is here based on the examination of material collected in the West Indies, the identification of which has been confirmed at Kew and the specimens pronounced to be typical *Nectria Bainii* Massee. This species differs from the two preceding only in the slightly larger ascospores.

Recent studies of two undescribed species of nectriaceous plants, both of which have been found to be associated with Verticillieae, have furnished the data for the present paper.

The first of these, collected in Mexico during the winter of 1910 by Dr. W. A. Murrill, was reported to be a parasite on the stems of an undetermined palm. The original collection showed numerous pinkish stromata covering the stems of the host. A study of the microscopic characters showed the fungus to be one of the Verticillieae, and it was at once suspected that the fungus might be the conidial phase of a *Nectria* or one of the related genera. This suspicion was confirmed by the finding of other specimens of the host with both the conidia and perithecia. The conidia and perithecia were so intimately associated that it seemed likely that they represented two stages in the life history of the same fungus.

The ascospores are of an olivaceous or smoky-brown color, which character would place the fungus in the genus *Macbridella.* This genus was founded by the writer* to include two species of colored-spored, stromatic Nectrieae, both of which were collected in Central America. The occurrence of a new and third species of this genus in Mexico is of interest from the standpoint of distribution. It is also of interest to note that a fourth species which would properly belong to this genus has been reported from South America. These facts would indicate that the genus is composed largely of tropical species. The three North American

* Mycologia 1: 195. 1909.

species reported, while clearly belonging to the same genus, are specifically very different. The fact that this species occurs on the living stems of the host and is apparently connected with a group of fungi which is of some economic importance prompted an investigation of its life history.

CULTURE EXPERIMENTS

Drop cultures were made of the conidia and ascospores and both were found to be in a germinating condition. The ascospores produce usually two germ-tubes, which in twenty-four hours attain considerable length.

The host of the parasite was undetermined, and a small piece of the leaf was the only clue which we had as to its identity. In order to select a suitable host on which to cultivate the fungus, a visit was made to the palm house of the conservatories of the New York Botanical Garden with the hope or finding a plant similar to the fragment brought from Mexico. The leaves of plants of the genus *Chamaedorea* resemble the Mexican specimen, and a species of this genus was selected (*Chamaedorea Sartorii*) which was known to occur in Mexico. Unfortunately, the plants of this genus were not sufficiently abundant in the conservatories to permit of a living plant being used for inoculation, so a leaf was removed and the petiole used in our preliminary experiments.

The petiole was cut into pieces 2–3 inches in length. One of these was split and the inoculations made the full length of the split surface with the conidia from the original collection. The other speicmens were inoculated on the cut ends only. All were placed in test tubes with the lower ends immersed in distilled water. In about ten days, the split stems showed an abundant infection, the conidia being more or less effused and nearly covering the whole of the cut surface. The stromata later appeared on the opposite side of the stem, being at first scattered but later becoming more or less confluent. The color, as in the original specimen, was at first white, becoming pink with age. The plants were identical both in gross appearance and microscopic characters with the specimens from which the inoculations were made.

The specimens which were inoculated on the cut ends only took

the infection more slowly. The stems gradually became blackened, as was also the case in the preceding experiment, the stromata appearing as small pustules near the end of the stem, and gradually spreading down its side.

Other inoculations were made in a similar way on the petioles of the same and other species of *Chamaedorea,* and an abundant infection of the conidia followed in nearly every case. All of the culture material was allowed to remain moist, with the hope of producing perithecia. The latter part of April, about two months from the time of the planting of the conidia, perithecia were observed in two of the cultures, being produced in small clusters or occasionally more or less scattered. Perithecia were later seen in one of the cultures belonging to the second set of inoculations.

Both the perithecia and spores in the culture-grown specimens differed slightly from the original material, but these differences seemed to be due to the fact that the specimens were not properly matured. The perithecia were dull-red in color, while in the original material they were covered with olivaceous granules. The spores, also, were almost destitute of color. However, all of the morphological characters with the exception of the two mentioned above indicate that the species grown in culture is identical with the one from which the inoculations were made. The species may be described as follows:

Macbridella olivacea sp. nov.

Stromata erumpent, with a rather compact center, overtopped by numerous branching conidiophores, giving the whole a loose floccose appearance, at first white, becoming pink, about 1 μ in diameter, scattered or confluent; conidiophores verticillate-branched; conidia borne in chains, ellipsoid, $4–5 \times 5–6\,\mu$; perithecia occurring in cespitose clusters on or surrounding the stroma, dull-reddish, covered with olivaceous granules, giving the clusters a dark, greenish-black color; asci cylindric, 8-spored; spores 1-seriate, with the ends overlapping, fusoid or subelliptic, at first hyaline and surrounded by a transparent envelope, 1-septate, becoming olivaceous or smoky-brown and slightly constricted at the septum, externally marked with coarse striations, giving the surface a roughened appearance, with an oil-drop in each cell, $12–15 \times 8\,\mu$.

Type collected at Motzorongo, Mexico, on the stems of an undetermined wild palm, January 15, 1910, *W. A. Murrill 911*.

DISTRIBUTION: Known only from the type locality.

The second species described in this paper was first observed in the propagating houses of the New York Botanical Garden in

FIG. 1. Colonies of *Nectria zonata* Seaver spreading over green algae on flower pot.

1906, where it was found growing on the surface of soil covered with green algae. It was also later observed on the outside of pots containing living plants, always, so far as observed, spreading over green algae, *Pleurococcus*, etc. During the last two

years it has been under observation on such habitats, as it appeared continuously during this period on various pots in different parts of the propagating houses (*fig. 1*).

The most characteristic feature of the species is the appearance of a scant mycelial growth, which gradually radiates out from a common center and apparently originates from a single infection. As the mycelium proceeds outward, forming concentric rings or zones, it disappears in the center, leaving a bare space surrounded by the gradually enlarging rings of mycelium. The perithecia later appear scattered over the mycelial growth or in the central portion where the mycelium has disappeared. The mycelium is very scant and never, so far as observed, gives rise to a stroma, but at intervals under favorable conditions produces very delicate white tufts of conidiophores bearing conidia. While apparently belonging to the Verticillieae, both conidiophores and conidia are very different from those of the preceding species (*pl. 30*). The characters mentioned above would place this species in the genus *Nectria*. A diagnosis of the species follows.

Nectria zonata sp. nov.

Perithecia preceded by a scant mycelial growth which radiates from a common center, giving rise to concentric rings or zones, finally disappearing in the center, leaving a bare space surrounded by the gradually expanding rings of mycelium, with the conidiophores and conidia appearing as delicate white tufts; conidiophores verticillate-branched, with the conidia-bearing branches enlarged below, gradually tapering toward the apex; conidia borne in chains, fusiform, 10–12 × 5 μ, granular within and often appearing very minutely roughened; perithecia scattered, rarely two together, numerous, pale-orange or flesh-red, becoming slightly darker in dried specimens, under conditions of moisture covered, especially near the base, with a mycelial growth giving the plants a whitish appearance, or entirely naked; ostiolum slightly prominent, entire or rarely collapsing in dried specimens; asci clavate, 8-spored; spores partially 2-seriate or irregularly crowded, unequal-sided, broad-fusoid, 1-septate, slightly constricted at the septum, with the lower of the two cells narrower, filled with numerous oil-drops, hyaline, 17–18 × 8–9 μ.

Type collected in the propagating houses of the New York Botanical Garden on the outside of a pot containing living plants, May 20, 1910, *F. J. Seaver*.

DISTRIBUTION: Known only from the type locality.

EXPLANATION OF PLATE XXX

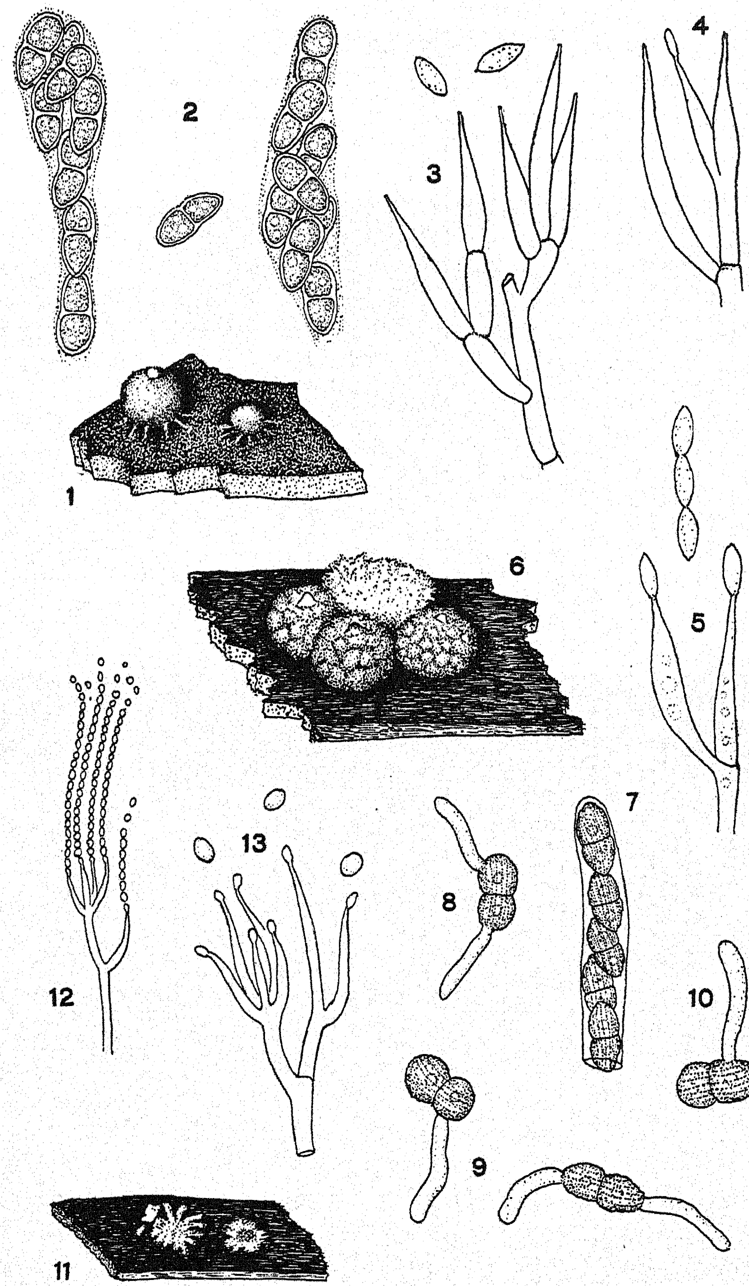
FIGS. 1–5. *Nectria zonata* Seaver

1. Perithecia.
2. Asci and spores.
3–5. Conidiophores and conidia.

FIGS. 6–13. *Macbridella olivacea* Seaver

6. Perithecia and stroma.
7. Portion of an ascus with spores.
8–10. Germinating ascospores after twenty hours in drop culture.
11. Young stromata.
12. Conidiophore and conidia (partially diagrammatic).
13. Conidiophore and conidia.

Figs. 2–5, 7–10, and 13 were drawn with the aid of the camera lucida.



1–5. NECTRIA ZONATA SEAVER
6–13. MACBRIDELLA OLIVACEA SEAVER

THE POLYPORACEAE OF JAMAICA

William A. Murrill

The fungi of Jamaica have been much neglected since the time of Olaf Swartz, who described only a few species, until recent years, when Dr. L. M. Underwood, Professor F. S. Earle, Dr. and Mrs. N. L. Britton, and others, either connected with expeditions sent out by the New York Botanical Garden or registered for investigation at Cinchona, have collected material upon which practically all of our accurate knowledge of the fungi of Jamaica is based.

The following list contains the species of polypores found in Jamaica, with the exception of a few white resupinate forms upon which I am not at present prepared to publish. The numbers here given are my own, unless otherwise stated. Mr. William Harris collected with me in the Cockpit Country. The localities and dates of my collections are as follows:

1. Rocky, shaded ravine east of Hope Gardens, 800 ft., dry region. December 12, 1908.
2. Constant Spring Hotel Grounds and ravines in vicinity, 600 ft., rather dry region. December 13, 1908.
3. Castleton Gardens, 600 ft., wet and shaded. December 14–15, 1908.
4. Moore Town, 100–1000 ft., plantations in lowlands and virgin forests on hills, wet region. December 16, 1908.
5. Blue Hole, Priestman's River, and inland road toward Manchioneal, 10–400 ft., mostly in cocoanut plantations recently established or in pastures, wet region. December 17, 1908.
6. St. Margaret's Bay to Port Antonio, 5–50 ft., wet region. December 18, 1908.
7. Chester Vale, 3000–4000 ft., wet, mountainous region. December 21–24, 1908.
8. Cinchona, 4500–5200 ft., wet, mountainous region. December 25–January 8, 1908–9.
9. Morce's Gap, 5000 ft., very wet, mountainous region; tree ferns and filmy ferns in abundance. December 29, 30, January 2, 1908–9.
10. New Haven Gap, 5600 ft., wet, mountainous region. January 4, 1909.
11. Monkey Hill to Sir John Peak, 5800–6100 ft., very wet, mountainous region. January 5, 1909.
12. Hope Gardens and Constant Spring, 600 ft., lawns and thickets after rains. January 9–10, 1909.

13. Troy and Tyre, Cockpit Country, 2000 ft., wet, wooded, limestone region. January 12–14, 1909.
14. Moneague to Union Hill, 1200–2200 ft., wet, wooded, limestone region. January 17–18, 1909.

Tribe PORIEAE

FOMITIPORELLA UMBRINELLA (Bres.) Murrill, N. Am. Flora 9: 13. 1907. Collected at Rose Hill in 1902 by F. S. Earle, and at Cinchona in 1906 by N. L. Britton.

FOMITIPORIA CINCHONENSIS Murrill, N. Am. Flora 9: 10. 1907. Described from specimens collected at Cinchona in 1902 by F. S. Earle.

FOMITIPORIA CUBENSIS Murrill, N. Am. Flora 9: 8. 1907. This species is usually seen on fence posts, growing in disk-shaped masses nearly an inch thick and several inches across.

Constant Spring Hotel, *36;* Cockpit country, *1046.*

FOMITIPORIA JAMAICENSIS Murrill, N. Am. Flora 9: 11. 1907. Described from specimens collected at Castleton in 1902 by F. S. Earle.

FOMITIPORIA TROPICALIS (Cooke) Murrill, N. Am. Flora 9: 8. 1907. The largest of all the resupinate species, attaining a thickness of nearly two inches and extending for many feet on the under surface of logs.

Priestman's River, *233;* St. Margaret's Bay to Port Antonio, *241.*

Fuscoporella castletonensis sp. nov.

Effused, inseparable, irregular, rigid, corky, 1–2 mm. thick; margin thin, adnate, irregular, fertile, ferruginous: context conspicuous, ferruginous to fulvous; hymenium somewhat uneven, pale-ferruginous to umbrinous; tubes grayish-umbrinous, very short, much less than 1 mm. long, mouths about 7 to a mm., regular, edges thin, entire, rigid: spores ellipsoid, smooth, pale-ferruginous, $4–5 \times 2–3\,\mu$; cystidia straight, sharp, ferruginous, fulvous, abundant, $20\,\mu$ long, $4–5\,\mu$ thick at the base; hyphae ferruginous.

Type collected in Castleton Gardens, Jamaica, 200 m., on dead wood, December 14–15, 1908, *W. A. & Edna L. Murrill 58.*

FUSCOPORIA VITICOLA (Schw.) Murrill, N. Am. Flora 9: 4. 1907.

Found only at high elevations in Jamaica. Abundant in the eastern United States north of Florida.

Chester Vale, *344;* Cinchona, *656;* New Haven Gap, *756.*

Tribe POLYPOREAE

Abortiporus tropicalis sp. nov.

Pileus distorted, spatulate to reniform, laterally stipitate, tough, flexible, becoming almost rigid when dry, 1–2 × 2.5–3 × 0.2–0.4 cm.; surface spongy, finely tomentose, uneven, plane or depressed, rosy-ochraceous, anoderm; margin white, becoming reddish-brown when bruised, undulate to lobed, sterile: context white, duplex, with a firmer layer next to the tubes; tubes short, white within, mouths minute, invisible to the unaided eye, somewhat glistening, white, edges firm, obtuse to subacute, entire: spores globose, smooth, thin-walled, hyaline, copious, 4.5–6 μ: stipe ascending, expanding into the pileus, sometimes branched at the base, very irregular, cremeous, clothed like the pileus, tapering below, about 3 cm. long and 5–10 mm. thick.

Type collected in Hope Gardens, Jamaica, 200 m., attached to the base of a small dead stump, January 9–10, 1909, *W. A. Murrill 836.*

BJERKANDERA ADUSTA (Willd.) Karst. Medd. Soc. Faun. Fl. Fenn. **5**: 38. 1879. All the specimens from the Cockpit Country and one collection from Chester Vale (348) represent a small form, quite different from the usual form of temperate regions, which latter I have from Chester Vale and Cinchona.

Castleton Gardens, *78;* Chester Vale, *303, 348;* Cockpit Country, *890, 915, 974.*

CERRENELLA FARINACEA (Fries) Murrill, N. Am. Flora **9**: 74. 1908.

Chester Vale, *308½;* Cinchona, *412;* Cockpit Country, *844.*

COLTRICIA SPATHULATA (Hook.) Murrill, N. Am. Flora **9**: 93. 1908. Abundant in a grove on a southern slope.

Cockpit Country, *962, 1034, 1059.*

CORIOLELLUS SEPIUM (Berk.) Murrill, Bull. Torrey Club **32**: 481. 1905. This species is represented in Jamacia and Cuba by a darker, more irregular, and less reflexed form than the typical one of the eastern United States.

Chester Vale, *274;* Morce's Gap, *679.*

CORIOLOPSIS CAPERATA (Berk.) Murrill, N. Am. Flora 9: 77. 1908.

Cockpit Country, *891*.

CORIOLOPSIS FULVOCINEREA Murrill, N. Am. Flora 9: 76. 1908. Collected at Hope Gardens and Port Maria by Earle.

CORIOLOPSIS OCCIDENTALIS (Klotsch) Murrill, Bull. Torrey Club 32: 358. 1905. Abundant throughout the island.

Priestman's River, *209;* Chester Vale, *356;* Cockpit Country, *1114*.

CORIOLOPSIS RIGIDA (Berk. & Mont.) Murrill, N. Am. Flora 9: 75. 1908.

Abundant throughout the island.

Castleton Gardens, *65;* Preistman's River, *203;* Chester Vale, *280; Cockpit Country, 878, 998;* Moneague to Union Hall, *1121*.

CORIOLOPSIS SUBGLABRESCENS Murrill, N. Am. Flora 9: 77. 1908. Collected in the Cockpit Country in 1906 by L. M. Underwood.

CORIOLOPSIS TAYLORI Murrill, N. Am. Flora 9: 76. 1908.

Morce's Gap, *697*.

CORIOLOPSIS VITTATA (Ellis & Macbr.) Murrill, N. Am. Flora 9: 76. 1908.

Chester Vale, *292*.

CORIOLUS ARMENICOLOR (Berk. & Curt.) Pat. Tax. Hymén. 94. 1900. Collected at Mandeville by Cockerell. Difficult to distinguish from old and discolored *Coriolus membranaceus*. The type specimens are also much alike. However, I have excellent fresh specimens of *C. armenicolor* from Honduras, collected by M. E. Peck, that show the two species to be quite distinct.

CORIOLUS BRACHYPUS (Lév.) Murrill, Bull. Torrey Club 32: 646. 1906.

Coriolus effusus sp. nov.

Pileus very thin, flexible, broadly confluent, effused, shortly reflexed, the reflexed portion convex, laterally elongated, projecting 3–7 mm.; surface finely tomentose, white or pale-yellowish, slightly sulcate, especially near the margin, which is broadly sterile, milk-white, undulate: context thin, white, membranous; hymenium very irregular, varying according to the

position of the tubes, white or slightly yellowish; tubes very short, mouths circular or much elongated radially, edges thin, becoming lacerate-dentate or somewhat irpiciform: spores smooth, hyaline.

Collected at Chester Vale, Jamaica, 1100 m., on dead wood, December 22, 1908, *W. A. & Edna L. Murrill 261* (*type*), *309*.

Cockpit Country, *888, 987, 1001, 1027*.

Coriolus Hollickii sp. nov.

Pileus imbricate, substipitate, attached by a short, scutellate disk or tubercle, flabelliform, flexible to nearly rigid, rather thick for the genus, $4–6 \times 5–7 \times 0.5$ cm.; surface slightly radiate-rugose, multizonate, shallowly concentrically sulcate, opaque, glabrous, ochroleucous or ochraceous to pallid with pale-avellaneous zones; margin subacute, entire, fertile, concolorous: context milk-white, soft-corky, homogeneous, about 2 mm. thick; tubes stramineous within and without, becoming isabelline on drying, 2–3 mm. long, corky, rigid, mouths regular, nearly circular, glistening, 4–5 to a mm., edges thin, entire; spores hyaline.

Type collected at Union Hill, near Moneague, Jamaica, on a log in the woods, April 6–7, 1908, *N. L. Britton & Arthur Hollick 2779*.

CORIOLUS MAXIMUS (Mont.) Murrill, Bull. Torrey Club **34**: 467. 1907. Very abundant throughout the island.

Cinchona, *472*; Cockpit Country, *897*.

CORIOLUS MEMBRANACEUS (Sw.) Pat. Tax. Hymén. 94. 1900. Very abundant throughout the island.

Constant Spring Hotel, *29*; Moore Town, *153, 161*; St. Margaret's Bay to Port Antonio, *243*; Cinchona, *503*; Cockpit Country, *883, 893, 908*; Moneague to Union Hill, *1162*.

CORIOLUS PAVONIUS (Hook.) Murrill, N. Am. Flora **9**: 25. 1907. Abundant throughout the island.

Castleton Gardens, *108*; Priestman's River, *179, 216*; Chester Vale, *317*; Hope Gardens and Constant Spring, *841*; Cockpit Country, *874*; Moneague to Union Hill, *1147, 1148*.

Coriolus pertenuis sp. nov.

Pileus very thin, coriaceous, flexible, dimidiate, nearly plane, sessile by a narrow base, $2.5 \times 3 \times 0.1–0.2$ cm.; surface slightly concentrically furrowed, glabrous, stramineous; margin thin, entire, sterile, cremeous: context white, fibrous, membranous;

hymenium ochraceous when viewed at an angle, nearly fulvous when looked at perpendicularly; tubes punctiform, less than 1 mm. long, mouths very regular, angular, about 5 to a mm., edges thin, entire: spores smooth, hyaline.

Type collected at Chester Vale, Jamaica, 1100 m., on dead wood, December 22, 1908, *W. A. & Edna L. Murrill 397.*

CORIOLUS PINSITUS (Fries) Pat. Tax. Hymén. 94. 1900. Very abundant throughout the island.

Castleton Gardens, *94;* Chester Vale, *318;* Cinchona, *460;* Cockpit Country, *1079;* Moneague to Union Hill, *1168.*

CORIOLUS SECTOR (Ehrenb.) Pat. Tax. Hymén. 94. 1900.

Cinchona, *612;* Cockpit Country, *1091.*

CORIOLUS VERSICOLOR (L.) Quél. Ench. Fung. 175. 1886. Seen only at high elevations. Previously collected on Rose Hill by Earle and on John Crow Peak by Underwood.

Cinchona, *465, 470, 502, 650;* Morce's Gap, *704;* New Haven Gap, *776.*

CYCLOPORELLUS IODINUS (Mont.) Murrill, N. Am. Flora **9**: 85. 1908.

East of Hope Gardens, *9, 11;* Chester Vale, *303½;* Cinchona, *657;* Morce's Gap, *673½;* Monkey Hill to Sir John Peak, *786;* Cockpit Country, *990, 1100.*

FLAVIPORUS RUFOFLAVUS (Berk. & Curt.) Murrill, Bull. Torrey Club **32**: 360. 1905.

Castleton Gardens, *85.*

FUNALIA VILLOSA (Sw.) Murrill, Bull. Torrey Club **32**: 356. 1905.

Cockpit Country, *920, 1119.*

HAPALOPILUS GILVUS (Schw.) Murrill, Bull. Torrey Club **31**: 418. 1904. Abundant throughout the island.

Chester Vale, *257, 279;* Cinchona, *628;* Cockpit Country, *906;* Moneague to Union Hill, *1182.*

HAPALOPILUS LICNOIDES (Mont.) Murrill, Bull. Torrey Club **31**: 417. 1904.

Constant Spring Hotel, *28;* Priestman's River, *222;* Chester Vale, *268, 285;* Cockpit Country, *904, 979, 984.*

HEXAGONA CUCULLATA (Mont.) Murrill, Bull. Torrey Club **31**: 332. 1904. Collected at Hollymount in 1906 by L. M. Underwood.

HEXAGONA DAEDALEA (Link) Murrill, Bull. Torrey Club **31**: 328. 1904.

Cockpit Country, *967, 969, 1042, 1110;* Moneague, *1170.*

HEXAGONA FRAGILIS Murrill, Bull. Torrey Club **31**: 329. 1904. Described from specimens collected at Port Antonio in 1902 by F. S. Earle.

HEXAGONA MAXONI Murrill, N. Am. Flora **9**: 49. 1907. Collected on Blue Mountain Peak in 1903 by L. M. Underwood.

HEXAGONA SUBCAPERATA Murrill, N. Am. Flora **9**: 50. 1907. Described from specimens collected at Port Antonio in 1902 by F. S. Earle.

Castleton Gardens, *54.*

HEXAGONA TESSELLATULA Murrill, Bull. Torrey Club **31**: 330. 1904.

Cockpit Country, *1049.*

INONOTUS CORROSUS Murrill, Bull. Torrey Club **31**: 598. 1904. Collected at Troy in 1906 by L. M. Underwood.

INONOTUS FULVOMELLEUS Murrill, N. Am. Flora **9**: 87. 1908. Described from specimens collected on Blue Mountain Peak in 1903 by L. M. Underwood, who also found it at New Haven Gap and on Sir John Peak. The species is known only from the Blue Mountains, at elevations of 5500 ft., or more.

New Haven Gap, *768;* Sir John Peak, *810.*

INONOTUS JAMAICENSIS Murrill, Bull. Torrey Club **31**: 597. 1904. Described from specimens collected by L. M. Underwood in 1903 on Mabess River, north of Cinchona and about 2000 ft. lower.

IRPICIPORUS LACTEUS (Fries) Murrill, N. Am. Flora **9**: 15. 1907. Previously collected in the Cockpit Country by Underwood and at Cinchona by D. S. Johnson.

Cinchona, *486.*

MICROPORELLUS DEALBATUS (Berk. & Curt.) Murrill, Bull. Torrey Club **32**: 483. 1905. Previously collected at Hollymount by L. M. Underwood.

Morce's Gap, *718;* Sir John Peak, *796;* Cockpit Country, *1074, 1102.*

MICROPORELLUS PORPHYRITIS (Berk.) Murrill, N. Am. Flora 9: 53. 1907.

Cockpit Country, *1052.*

NIGROPORUS VINOSUS (Berk.) Murrill, Bull. Torrey Club **32**: 361. 1905.

Cockpit Country, *859.*

POGONOMYCES HYDNOIDES (Sw.) Murrill, Bull. Torrey Club **31**: 609. 1904. Very abundant throughout the island.

Cockpit Country, *889;* Chester Vale, *359.*

POLYPORUS ARCULARIUS (Batsch) Fries, Syst. Myc. **1**: 342. 1821. Collected at Hope Hill in 1906 by D. S. Johnson.

POLYPORUS BLANCHETIANUS Berk. & Mont. Ann. Sci. Nat. III. **11**: 238. 1839.

Cockpit Country, *1038;* Moneague, *1132.*

Polyporus praeguttulatus sp. nov.

Pileus subcircular in outline, convex above, nearly plane below, attached by a decurrent base, which causes the sporophore to appear triangular in section, $4 \times 4.5 \times 0.5$–2.5 cm.; surface smooth, latericious, with a coating of fine, grayish tomentum, which disappears in numerous subcircular spots; margin slightly upturned, abruptly acute, concentrically striate, entire, cremeous: context pallid, soft-corky, homogeneous, 1 cm. thick behind; tubes stramineous, 3–4 mm. long, mouths subcircular to angular, larger near the margin, most of them about 3 to a mm., glistening, stramineous, edges thin, entire: spores smooth, ovoid, hyaline, 5–6×2–$3\,\mu$; hyphae hyaline; stipe obsolete.

Type collected in Troy and Tyre, Jamaica, 650 m., on a log in woods, January 12–14, 1909, *W. A. Murrill & W. Harris 1105.*

POLYPORUS SCABELLUS (Pat.) Murrill, N. Am. Flora 9: 63. 1907. Collected at Morce's Gap in 1906 by D. S. Johnson.

POLYPORUS SUBELEGANS Murrill, N. Am. Flora 9: 62. 1907.

Moore Town, *148;* Cockpit Country, *971, 986, 997.*

POLYPORUS TRICHOLOMA Mont. Ann. Sci. Nat. II. **8**: 365. 1837.

Common at low elevations on fallen branches and sticks.

Priestman's River, *225;* Hope Gardens & Constant Spring, *831;* Cockpit Country, *889½;* Moneague to Union Hill, *1185.*

PYCNOPORUS SANGUINEUS (L.) Murrill, Bull. Torrey Club 31: 421. 1904. Very abundant throughout the island.

Morce's Gap, *713;* Cockpit Country, *921, 958.*

RIGIDOPORUS SURINAMENSIS (Miq.) Murrill, Bull. Torrey Club 34: 473. 1907. Delighting in very wet logs. Difficult to distinguish from small specimens of *Fomes Auberianus.*

Castleton Gardens, *62, 132;* Moore Town, *138;* Priestman's River, *213, 219.*

SPONGIPELLIS LURIDESCENS Murrill, N. Am. Flora 9: 39. 1907. Described from specimens collected at Hall's Delight in 1902 by F. S. Earle.

TRAMETES CUBENSIS (Mont.) Sacc. Syll. Fung. 9: 198. 1891.

St. Margaret's Bay to Port Antonio, *254;* Chester Vale, *350;* Cockpit Country, *862, 914;* Moneague to Union Hill, *1161.*

TRAMETES HAVANNENSIS (Berk. & Curt.) Murrill, N. Am. Flora 9: 44. 1907.

Priestman's River, *196.*

Trametes jamaicensis sp. nov.

Pileus laterally connate, effused-reflexed, the reflexed portion triangular in section, convex above, concave below, corky, rigid, 1–1.5 × 2–5 × 0.5–0.8 cm.; surface slightly uneven, finely tomentose, becoming nearly glabrous, whitish to discolored, opaque, anoderm, azonate; margin subobtuse, entire, fertile, concolorous: context homogeneous, soft-corky, white, 2–3 mm. thick; tubes 2–5 mm. long, rather slender, white within, mouths about 4 to a mm., slightly angular, glistening, edges thin, entire, rigid, white to slightly discolored: spores hyaline; cystidia none.

Type collected near Blue Hole, Jamaica, 60 m., on dead wood, December 17, 1908, *W. A. Murrill 187.*

TRAMETES SUBMURINA Murrill, N. Am. Flora 9: 43. 1907. More abundant during the rainy seasons, as shown by the collections of F. S. Earle.

Priestman's River, *217, 226, 235;* Castleton Gardens, *102.*

Trametes subscutellatus sp. nov.

Pileus tough to rigid, concave below, convex above, vertically attached, circular in outline, 1 cm. broad, 2 mm. thick; surface nearly smooth, with a thin pellicle, ochraceous, except at the vertex, where it is latericious to castaneous; margin subobtuse or

acute, deflexed, white, entire: context white, firm, fibrous, homogeneous; tubes 1 mm. long, stramineous within and without, mouths regular, 4–5 to a mm., circular to slightly angular, glistening, edges obtuse, entire: spores hyaline; cystidia none.

Type collected between Moneague and Union Hill, Jamaica, 500 m., on dead wood, January 17, 1909, *W. A. & Edna L. Murrill 1129.*

TRICHAPTUM TRICHOMALLUM (Berk. & Mont.) Murrill, Bull. Torrey Club **31**: 608. 1904. Collected at Mansfield near Bath in 1903 by L. M. Underwood.

TYROMYCES CAESIUS (Schrad.) Murrill, N. Am. Flora **9**: 34. 1907. Abundant about Cinchona on dead branches of *Juniperus barbadensis.*

Castleton Gardens, *60;* Cinchona, *453, 479, 541, 554, 572;* New Haven Gap, *778.*

Tyromyces cinchonensis sp. nov.

Pileus imbricate, flabelliform, attached by a narrow base, convex above, concave below, slightly flexible, becoming rigid and fragile when dry, 2.5 × 2.5 × 0.2–0.3 cm.; surface milk-white, becoming suffused with avellaneous or very pale ardesiacous markings, perfectly glabrous, radiate-rugose; margin thin, undulate or eroded, deflexed on drying, concolorous: context white, thin, fibrous, rather tough for the genus; tubes white, much longer than the thickness of the context, averaging about 2 mm., mouths angular, regular, white with an ashy tint, glistening, 5–6 to a mm., edges thin, becoming slightly lacerate-dentate: spores cylindric, curved at times, smooth, hyaline, 4 × 1.5–2.5 μ.

Type collected at Cinchona, Jamaica, 1670 m., on a coniferous log, December 25–January 8, 1908–9, *W. A. & Edna L. Murrill 500.* Also collected at the same time at the base of a dead sapling (*No. 509*).

TYROMYCES LACTEUS (Fries) Murrill, N. Am. Flora **9**: 36. 1907. These specimens differ somewhat from the usual form found in temperate regions and the spores are broader, measuring 3.5–4.5 × 1.5–2.5 μ.

Cinchona, *516.*

TYROMYCES LEUCOMALLUS (Berk. & Curt.) Murrill, N. Am. Flora **9**: 36. 1907.

Cockpit Country, *1108½.*

TYROMYCES PALMARUM Murrill, N. Am. Flora 9: 32. 1907.
Collected at Hope Gardens in 1902 by F. S. Earle.

Tribe FOMITEAE

Amauroderma Brittonii sp. nov.

Sporophores of immense size, two growing side by side and slightly united in the type collection; pileus circular in outline, nearly plane, rather soft when fresh, becoming rigid and fragile when dry, over 30 cm. broad in a dried condition and probably 50 cm. when fresh; surface uneven, somewhat sulcate, castaneous to fuliginous, pelliculose, pruinose, opaque, becoming very much wrinkled and uneven on drying: context punky when dry, avellaneous, homogeneous, bounded above and below by a thin, dark layer about 2 mm. thick; hymenium grayish when fresh, becoming brownish on drying and blackening where bruised; tubes minute, irregular, very short, less than 5 mm., much darker than the context, being dark-fumose in dried specimens, mouths slightly angular, 2–3 to a mm., stuffed when young, edges thin, entire, rigid: spores subglobose, slightly fuscous, finely asperulate, 7–8 μ: stipe subcylindric, short, central, slightly enlarged above and below, harder and more rigid than the pileus, encrusted, avellaneous, pruinose, glabrous, uneven, 10 cm. long, 6 cm. thick, no doubt larger in fresh specimens.

Type collected at Bachelor's Hall, Parish of St. Thomas, Jamaica, on a rotten log, September 15–19, 1908, *N. L. Britton 3630.*

AMAURODERMA RENATUM (Berk.) Murrill, N. Am. Flora 9: 117. 1908. Collected between Chapelton and Bull Head in 1906 by L. M. Underwood.

ELFVINGIA FASCIATA (Sw.) Murrill, Bull. Torrey Club 30: 298. 1903.

Cockpit Country, *846.*

ELFVINGIA TORNATA (Pers.) Murrill, Bull. Torrey Club 30: 301. 1903. Abundant throughout the island. Common on fallen pine logs at Cinchona.

Cinchona, *404, 442, 611;* Cockpit Country, *880;* Moneague to Union Hill, *1156.*

FOMES ANNOSUS (Fries) Cooke, Grevillea 14: 20. 1885. Seen only in the mountains.

Chester Vale, *305½;* Cinchona, *411, 427, 535.*

FOMES AUBERIANUS (Mont.) Murrill, Bull. Torrey Club **32**: 491. 1905. *Boletus microporus,* of Swartz is probably this species, judging from the fact that the latter is conspicuous and generally distributed.

Castleton Gardens, *119;* Priestman's River, *236*; St. Margaret's Bay to Port Antonio, *250, 253, 255;* Cockpit Country, *919, 1004, 1005.*

FOMES GEOTROPUS Cooke, Grevillea **13**: 119. 1884.
Cockpit Country, *944.*

FOMES OHIENSIS (Berk.) Murrill, Bull. Torrey Club **30**: 230. 1903.
Castleton Gardens, *126;* Chester Vale, *398.*

FOMES SAGRAEANUS (Mont.) Murrill, N. Am. Flora **9**: 96. 1908.
Chester Vale, *302.*

FOMES SUBFERREUS Murrill, N. Am. Flora **9**: 97. 1908.
Cockpit Country, *845, 944, 966, 1015.*

FOMITELLA SUPINA (Sw.) Murrill, Bull. Torrey Club **32**: 365. 1905. This species has been collected also near Kingston and at Bath, but it appears to be much less common in Jamaica than in Cuba and the Gulf States.
Cockpit Country, *910, 1033.*

GANODERMA SUBINCRUSTATUM Murrill, N. Am. Flora **9**: 122. 1908. Described from specimens collected at Hope Gardens in 1902 by F. S. Earle.
Constant Spring Hotel, *25.*

GANODERMA TUBERCULOSUM Murrill, N. Am. Flora **9**: 123. 1908.
Cockpit Country, *871, 1018.*

NIGROFOMES MELANOPORUS (Mont.) Murrill, Bull. Torrey Club **31**: 425. 1904.
Cockpit Country, *930, 982.*

PYROPOLYPORUS CALCITRATUS (Berk. & Curt.) Murrill, N. Am. Flora **9**: 110. 1908.
Cockpit Country, *1044.*

PYROPOLYPORUS CEDRELAE Murrill, N. Am. Flora **9**: 105. 1908. Described from specimens collected at Bluefields in 1902 by F. S. Earle.

Pyropolyporus cinchonensis sp. nov.

Pileus woody, triquetrous, very thick and broadly atached behind, convex, 5–7 × 8–12 × 7–10 cm.; surface horny-encrusted, glabrous, smooth, obscurely zonate, slightly sulcate, umbrinous to bay; margin very obtuse, ferruginous, slightly undulate, sterile: context rather hard, fulvous, zonate in recent layers, 0.5–2 cm. thick; tubes indistinctly stratified, avellaneous when young, becoming avellaneous-umbrinous, rather long and slender, sometimes 5 mm. or more long during a season, mouths minute, stuffed when young, circular, 5 to a mm., avellaneous-umbrinous, edges obtuse, entire: spores subglobose, smooth, pale-ferruginous, uniguttulate, 4 μ; hyphae ferruginous, 3–4 μ; cystidia ferriginous-fulvous, pointed, ventricose, scanty, about 20 μ long and 5–7 μ thick at the base.

Collected at Cinchona, Jamaica, 1500 m., on dead, standing, hardwood trunks in a dense virgin forest, December 25–January 8, 1908–9, *W. A. & Edna L. Murrill 446, 643* (*type*).

PYROPOLYPORUS EXTENSUS (Lév.) Murrill, N. Am. Flora **9**: 110. 1908.

East of Hope Gardens, *5;* Cockpit Country, *892, 913, 993.*

PYROPOLYPORUS DEPENDENS Murrill, N. Am. Flora **9**: 106. 1908.

Cockpit Country, *940.*

PYROPOLYPORUS HAEMATOXYLI Murrill, Bull. Torrey Club **30**: 117. 1903. Described from specimens collected at Paradise in 1902 by F. S. Earle.

Pyropolyporus hydrophilus sp. nov.

Pileus small, woody, undulate, usually laterally attached, 2–3 × 2–4.5 × 2–3.5 cm.; surface uneven, rugose, many times sulcate, bay to chestnut, with fuliginous lines, finely tomentose to nearly glabrous, horny-encrusted; margin subobtuse, melleous, entire: context scarcely 1 cm. thick, woody-punky, deep-ferruginous to fulvous; hymenium glistening, melleous when looked at from the side, olivaceous-umbrinous when viewed perpendicularly; tubes indistinctly stratified, fulvous with a grayish tint, 2–3 mm. long each season, mouths circular, 4–5 to a mm., edges obtuse, entire: spores subglobose, smooth, fulvous, uniguttulate, copious, thick-walled, 3.5–4.5 μ; hyphae ferruginous, fulvous, 4 μ; cystidia none.

Collected at Morce's Gap, Jamaica, 1860 m., on dead, standing saplings, December 29, 30, January 2, 1908–9, *W. A. & Edna L. Murrill 700, 717* (*type*).

PYROPOLYPORUS INFLEXIBILIS (Berk.) Murrill, N. Am. Flora **9**: 104. 1908. Collected on Rose Hill by F. S. Earle, and at Morce's Gap, John Crow Peak, Green River, and Cinchona by L. M. Underwood.

PYROPOLYPORUS JAMAICENSIS Murrill, Bull. Torrey Club **30**: 120. 1903. Described from specimens collected at Port Antonio in 1902 by F. S. Earle.

PYROPOLYPORUS ROBINSONIAE Murrill, N. Am. Flora **9**: 108. 1908. Described from specimens collected on Monkey Hill in 1904 by Miss W. J. Robinson.

PYROPOLYPORUS ROSEOCINEREUS Murrill, N. Am. Flora **9**: 104. 1908.

East of Hope Gardens, *1*.

PYROPOLYPORUS SUBPECTINATUS Murrill, N. Am. Flora **9**: 109. 1908.

Union Hill, *1158*.

Pyropolyporus troyanus sp nov.

Pileus woody, horny-encrusted, ungulate, rarely compressed-ungulate, usually plane below, sessile either by the vertex or laterally, 5–8 × 8–11 × 3–5 cm.; surface many times concentrically sulcate, slightly rimose in very old specimens, bay to nearly black, glabrous, even when young; margin slightly obtuse, entire or slightly undulate, ferruginous, sterile, slightly velvety: context woody, hard, about 1 cm. or less thick, fulvous, penetrated by dendroid markings of a black, horny appearance; tubes rather distinctly stratified, avellaneous-umbrinous, about 3 mm. long each season, mouths minute, about 8 to a mm., circular, fulvous, almost castaneous when young, edges obtuse, entire: spores globose, smooth, pale-yellowish, 3–4 μ; hyphae pale-yellowish; cystidia none.

Collected in Troy and Tyre, Jamaica, 650 m., on a dead log, January 12–14, 1909, *W. A. Murrill & Harris 980 (type) 1051*.

PYROPOLYPORUS UNDERWOODII Murrill, Bull. Torrey Club **30**: 116. 1903. Collected near Kingston in 1906 by D. S. Johnson.

Tribe DAEDALEAE

DAEDALEA AMANITOIDES Beauv. Fl. Oware **1**: 44. *pl. 25*. 1805. Abundant throughout the island.

East of Hope Gardens, *8*; Cinchona, *583*; Cockpit Country, *902*.

GLOEOPHYLLUM BERKELEYI (Sacc.) Murrill, Bull. Torrey Club **32**: 370. 1905.

Castleton Gardens, *70*.

GLOEOPHYLLUM HIRSUTUM (Schaeff.) Murrill, Jour. Myc. **9**: 94. 1903.

Chester Vale, *306½*.

GLOEOPHYLLUM STRIATUM (Sw.) Murrill, Bull. Torrey Club **32**: 370. 1905. Abundant at low elevations. First described by Swartz as *Agaricus striatus*.

Cockpit Country, *1066;* Moneague to Union Hill, *1171*.

LENZITES EARLEI Murrill, N. Am. Flora **9**: 128. 1908. Described from specimens collected at Port Antonio in 1902 by F. S. Earle.

NEWS AND NOTES

Cornell University has received an appropriation for three new buildings for the New York State College of Agriculture.

Dr. C. B. Plowright, a distinguished English naturalist, who devoted much of his time to the study of fungi, died early in May, at the age of fifty-one years.

Dr. E. Linhard and Dr. Kølpin Ravn, of Denmark, are visiting America to observe methods of forage crop production and applied plant pathology.

An international American scientific congress will be held in Buenos Aires from July 10 to 25, in celebration of the centenary of the revolution of May, 1810.

Dr. E. P. Meinicke has been called to Washington as expert in the Office of Investigations in Forest Pathology, Bureau of Plant Industry. This office has undertaken a vigorous campaign against forest diseases.

A very important paper by A. Potebnia on the microscopic fungi of middle Russia, containing many species not previously described and many figures, appeared in the February number of *Annales Mycologici.*

A list of the lichens of Ohio, by J. C. Hambleton, appeared in the *Ohio Naturalist* for January, 1910.

A. Sartory has investigated two species of *Chanterel, C. tubaeformis* Fr. and *C. aurantiacus* Wulf., supposed to be poisonous, and has come to the conclusion that they are harmless (Bull. Soc. Myc. Fr. **25**: 253, 254. 1909).

Mr. E. Bartholomew, of Stockton, Kansas, visited the Garden on June 3 and 4.

Dr. J. E. Kirkwood, research scholar at the Garden at various times from 1899 to 1904, has been appointed professor of botany and forestry at the University of Montana.

Dr. Charles E. Fairman, of Lyndonville, New York, spent two weeks at the Garden during the latter part of May, consulting the collection of Lophiostomaceae.

In the *Thesaurus* recently completed by Lindau & Sydow, there are 1710 pages, containing about 30,000 titles of books and articles on mycological subjects.

A number of new species of fungi from the Philippine Islands are described by H. & P. Sydow in *Annales Mycologici* for February, 1910.

A key to the New England species of *Cladonia,* and a list of the species of the Cladoniaceae occurring in New England, prepared by L. W. Riddle, appeared in *Rhodora* for November, 1909.

In the *Plant World* for September, 1909, V. W. Pool discusses the present status of plant pathology; the article being based upon replies to a circular letter to a number of men prominent in this field.

At the recent Brussels' congress, it was decided to take the date of publication of Fries' *Systema Mycologicum* as the starting point for the nomenclature of most of the fungi, and to go back to 1753 for the lichens, and to 1801 for certain other groups.

Professor H. J. Banker, of De Pauw University, Greencastle, Indiana, stopped at the Garden two weeks in June on his way to visit the principal European herbaria in preparation of a monograph of the Hydnaceae to appear in North American Flora.

Mr. H. S. Jackson, research scholar at the Garden in 1907, has been appointed professor of botany and plant pathology in the Oregon Agricultural College. Mr. Jackson has been since August, 1909, research assistant in plant pathology in the Oregon Agricultural Experiment Station.

The Torrey Botanical Club has arranged a special excursion for fungi to Cold Spring, Long Island, for August 6. The train leaves the foot of East 34th Street (Long Island R. R.) at 9:00 A. M. Returning trains leave at 4:49 and 6:51 P. M. Cost of trip, about two dollars. Guides, Mr. Seaver and Mr. Dodge.

Dr. William J. Gies, consulting chemist of the New York Botanical Garden, will conduct investigations of various species of poisonous fungi during the coming year. Contributions of specimens are desired from as many localities as possible. They should be collected in quantity and dried in the sun or in a current of warm air. Descriptive notes are of value for purposes of determination.

An illustrated work on the poisonous plants of Germany, by Dr. P. Esser, director of the Cologne Botanic Garden, has recently appeared. The fungi included in this work are: *Amanita phalloides, A. muscaria, A. pantherina, Russula emetica, R. foetens, Lactarius torminosus, Boletus lupinus, B. Satanas, Phallus impudicus, Scleroderma vulgare,* and *Claviceps purpurea.*

The American Phytopathological Society at its last meeting appointed a committee consisting of F. L. Stevens, H. von Schrenk, E. M. Freeman, W. A. Orton, and G. P. Clinton, to draw up rules and make recommendations concerning the common names of plant diseases, the object being to secure uniformity in their usage.

Leaf-blight of the plane-tree (*Gleosporium nervisequum*) was very conspicuous this season on the grounds of the Garden from the middle of May to the end of June, the continued rainy weather being especially favorable to the development of the

fungus. This severe attack, following so closely the epidemics of 1907 and 1908, will undoubtedly kill or severely injure many of the smaller branches of the plane-trees in this region.

Bulletin 118 of the Bureau of Plant Industry, United States Department of Agriculture, contains the results of four years of research in "Culture Studies of Species of *Penicillium*" by Dr. Charles Thom, mycologist in cheese investigation. Twenty-seven species and three varieties are described in this paper. In addition to morphological characters, the physiological effects upon nutrient media have been found to be reliable characters in separating some species and in such cases are introduced into the diagnoses of the species. The work is illustrated by thirty-six figures.

James B. Rorer, mycologist of the Board of Agriculture of Trinidad, has recently been investigating several diseases that threaten the cacao, cocoanut, and banana industries of the American tropics (see Bull. Trinidad Dep. Agric. no. 64. 1910, and Trinidad Agric. Soc. Paper 412). Mr. Rorer believes that thorough sanitation, by burning in the dry season and burying in rainy weather, is the best means of combatting the bud-rot disease of cocoanut palms; and he recommends the passage of an ordinance compelling all owners of cocoanut plantations to destroy trees affected with this disease.

An extended report of the Boston meeting of the American Phytopathological Society, by Dr. C. L. Shear, secretary, appeared in *Science,* May 13 and May 20, 1910. The Society was organized with 130 charter members, and 50 of these were present at the meeting. Three sessions were devoted to the reading of papers, abstracts of which appear in the secretary's report. Among the many interesting things brought forward, the following may be mentioned:

Puccinia Malvacearum on the hollyhock may be readily communicated by artificial inoculation to *Malva rotundifolia,* or *vice versa.*—Malnutrition diseases of cabbage, spinach, and other vegetables in trucking sections along the Atlantic coast, apparently

due to abnormal quantities of acids in the soil, may be prevented by the application of calcium carbonate.—The smuts of the *Tilletia* group appear to be more nearly related to the rusts than those of the *Ustilago* group.—The present range of the chestnut canker, *Diaporthe parasitica,* is from Saratoga County, N. Y. and Suffolk County, Mass., to Westmoreland County, Pa. and Greenbriar and Preston Counties, W. Va.—A very large part of the potato rot in the United States is due to *Bacillus phytophthorus* Appel.

The Central American banana blight, which has become very serious in recent years, may be retarded in its early stages by replacing diseased plants with healthy ones, but the hope of continuing the banana industry in affected districts lies in the substitution of an immune Chinese variety for the Martinique variety now commonly cultivated.—Lettuce sclerotiniose may probably be eradicated by the early destruction of affected plants, thus preventing the formation of sclerotia.—An anthracnose of red clover (*Gleosporium caulivorum*) spreads rapidly during warm, showery weather when succulent growth is produced.—It is probable that ascospore infection is, in most cases, largely responsible for early attacks of apple scab on the leaves and petioles.—It has been found that *Polystictus hirsutus* Fr. may slowly attack the cambium of mountain ash, gradually killing the tree.—It is possible that there are two banana diseases in tropical America confused, one due to bacteria and the other to a *Fusarium.*

The appearance of *Mycogone perniciosa* Magnus in mushroom beds in Pennsylvania introduces a serious menace to mushroom growing in America.—*Phytophthora Cactorum,* long known to ginseng growers in Japan, has appeared in Ohio and New York, and has been successfully isolated and inoculated into ginseng plants.—Floret sterility of wheat in the Southwest is largely due to rusts and associated fungi, chiefly an undescribed species of *Stemphylium,* distributed by minute insects and the wind at the period of flowering.—A new disease of the tomato plant, due to *Bacterium* (?) *michiganense* E. F. Smith, has been found prevalent in the vicinity of Grand Rapids, Mich.—The use of sulfur to control potato scab in California has resulted in injury to the

tubers, producing sunken, dark spots 5–30 mm. in diameter.—A stem-rot of beans due to *Rhizoctonia* has been observed near Oneida, N. Y.

The Genus Sphaerosoma.—Prof. W. A. Setchell, of the University of California, has recently published a paper on "The Genus Sphaerosoma" (Univ. of Calif. Pub. 4: 107–120, *pl. 15*). This paper is the outgrowth of the study of specimens of a new fungus collected in California which at first seemed to belong to the genus *Sphaerosoma*. The following is a brief synopsis of his conclusions:

The genus *Sphaerosoma* was founded by Klotzsch in 1839, *Sphaerosoma fuscescens*, an echinulate-hyaline-spored species being the type of the genus. A second species, *Sphaerosoma ostiolatum*, was described by Tulasne in 1851. This species is characterized by the brown-bluntly-tuberculate ascospores. In 1854, Zobel in the sixth volume of Corda's Icones Fungorum established a new genus, *Sphaerozone*, for *Sphaerosoma ostiolatum* Tul., which was described under the name *Sphaerozone Tulasnei* Zobel. In 1885, Hesse described a third species, *Sphaerosoma fragile*. In 1903, Hennings described, under the name *Ruhlandiella berolinensis*, a fungus which he considered close to *Sphaerosoma*, with reticulate-verrucose spores. In 1905, Seaver described a fourth species of *Sphaerosoma* under the name of *Sphaerosoma echinulatum*. In 1905, Rehm distributed (Ascom. *1601*) specimens from upper Silesia under the name of *Sphaerosoma echinulatum* Seaver. In 1908, Rouppert described a fourth species of *Sphaerosoma* under the name of *Sphaerosoma Janczewskianum*, and in 1909 published a monograph of the genus *Sphaerosoma* in which he recognized four species as belonging to the genus *Sphaerosoma*, one of which has reticulate spores, one verrucose spores, and two echinulate spores.

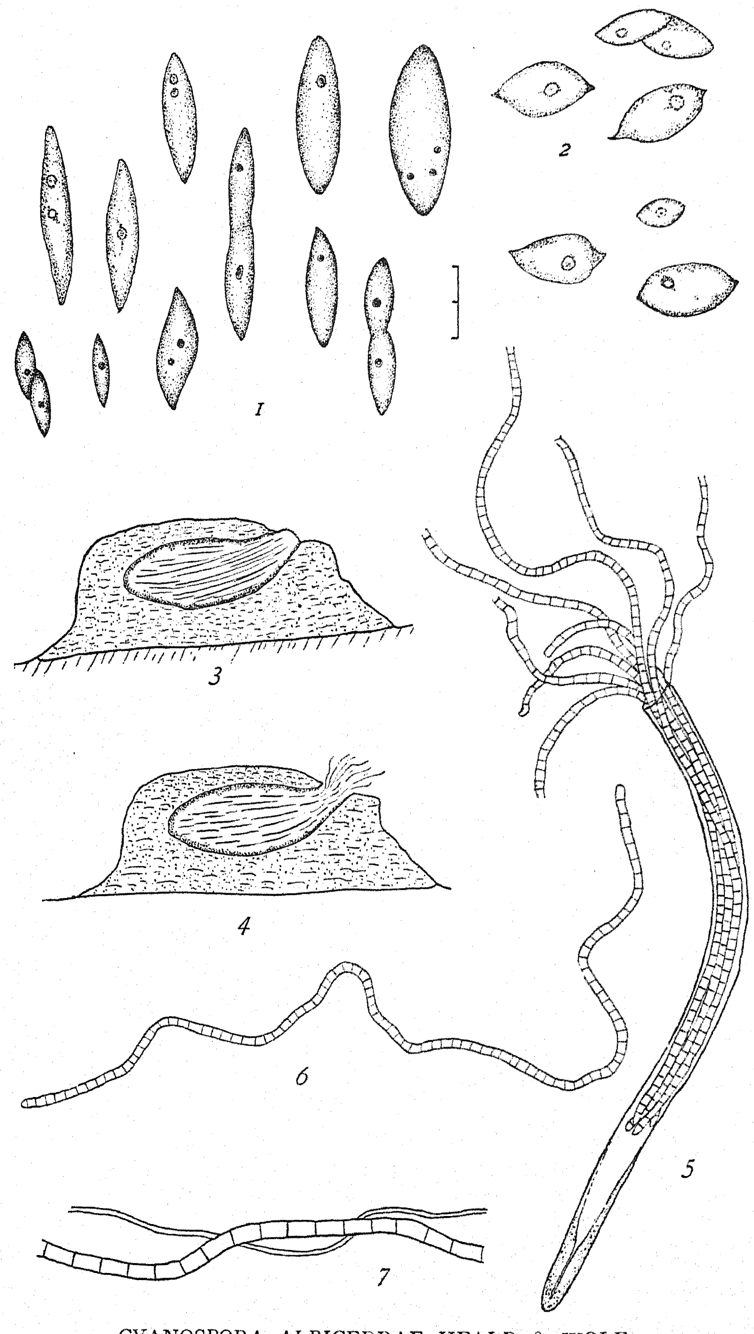
Setchell believes that the genus *Sphaerosoma* should be restricted to the echinulate-spored species, *Sphaerosoma fuscescens* Klotzsch (the type of the genus) and *Sphaerosoma echinulatum* Seaver, and that, since the European form of *Sphaerosoma echinulatum* differs from the American in having shorter and more slender spore-spines, it may come to be regarded as a

distinct species or may be only a geographical variety of the Iowa species.

The genus *Sphaerozone* Zobel should include the brown-verrucose-spored species, *Sphaerozone ostiolatum* (Tul.) Setchell. The new combination is published by Setchell, since, although the genus was based on this species, it was included by Zobel under the name *Sphaerozone Tulasnei*.

The genus *Ruhlandiella* was described by Hennings and based on a brown-reticulate-spored species, and, as stated above, was thought by Hennings to be closely related to *Sphaerosoma*. The Californian specimens are made the basis of a new species belonging to this genus, which is published by Setchell under the name *Ruhlandiella hesperia*.

From his study of the specimens of *Sphaerosoma* (in its restricted sense), Setchell believes that the plants of the genus are hemicleistocarpous and therefore belong more properly with the Pezizineae than with the Helvellineae, as has formerly been thought, and, since the plants have a weakly developed peridium, he suggests a possible relationship with the Pyronemaceae rather than with the Pezizaceae—F. J. SEAVER.



CYANOSPORA ALBICEDRAE HEALD & WOLF

MYCOLOGIA

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THE WHITENING OF THE MOUNTAIN CEDAR, SABINA SABINOIDES (H.B.K.) SMALL

F. D. HEALD AND F. A. WOLF

(WITH PLATE 31, CONTAINING 7 FIGURES)

INTRODUCTION

During the past two years a diseased condition of the mountain cedar has been made the subject of observation and study. This condition is produced by one of the ascigerous fungi, which, because of its peculiar structure, we were unable to assign to any described species. For this reason, some of the diseased material was sent to Professor C. H. Peck for identification. Because of several important structural characters in which it did not agree with previously described forms, he was unable to refer it to any known genus of fungi, stating, however, that its morphology most resembled that of *Ophioceras*.

Since receiving this information from Professor Peck, the collections at the National Museum at Washington and at the New York Botanical Garden have been examined by the senior author, and no previous collections of this fungus have been found.

GENERAL CHARACTERS

The most prominent symptom which is associated with the presence of this fungus is the occurrence of whitened areas on the trunk and branches of the affected trees. These areas may be small, although most frequently they are quite extensive. These

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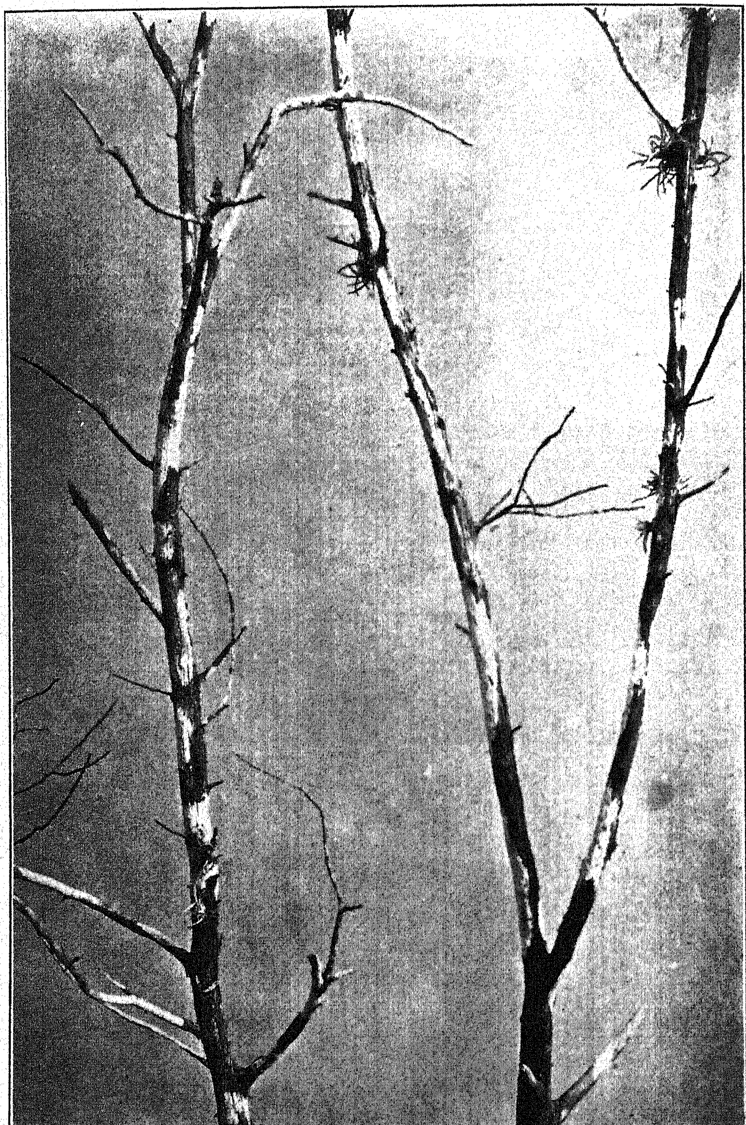

FIG. 1. View of host showing the conspicuous patches on which the fungus fruits are located.

white patches are so commonly found on the mountain cedar that Bray* used this character as one of the peculiarities by which to identify the tree (*fig. 1*). Upon these whitened areas may be found stromatic nodules containing the fruits of the fungus. On the older affected parts the branches become decorticated and the wood corroded so that dark, very prominently projecting wood nodules remain (*fig. 2*). On large trunks or branches or on parts not diseased for so long a time, the grayish nodules are embedded in the tissue of the bark and project only slightly or quite prominently (*fig. 3*). These nodules occur singly, or quite frequently two (rarely three) have fused end to end or partially along one side. They vary in length from less than 1 mm. to 2.25 mm. and are more or less lenticular in form. Those on the wood (*pl. 31, f. 1*) are more frequently longer and not so wide as those on the bark (*pl. 31, f. 2*), the latter being more nearly oval.

Projecting from the nodules are one to three short papillae, marking the ostioles of the embedded perithecia. The ostioles are rarely in the center of the nodule but typically nearer one end (*pl. 31, f. 1, 2*). The perithecia are prostrate, the neck of the perithecium being bent upward toward the surface (*pl. 31, f. 3, 4*). They are flask-shaped, with a slightly tapering neck, and vary in size from $825–1200 \times 260–400\mu$. By the corrosion of the tissue of the nodule, an elongated cavity is formed, the cavity-wall serving as the perithecial wall and being lined with only a delicate fungous membrane.

The numerous cylindrical asci, each containing six or eight filamentous spores, are embedded in a mucilaginous substance. When the nodules are moistened, the swelling of this mucilaginous matrix causes the extrusion of the asci and spores (*pl. 31, f. 4*) from the ostiole. The asci vary in size from $800–1100 \times 8–10\mu$ and have a very characteristically thickened apical wall, which compels the rupture of the lateral walls toward the base of the ascus. The spores which project from the broken basal end (*pl. 31, f. 5*) are always more or less coiled or twisted in response to the presence of moisture. The spores are very long, ranging

* Bray, W. L. Forest Resources of Texas; Bull. U. S. D. A., Bureau of Forestry 47: 54. 1904.

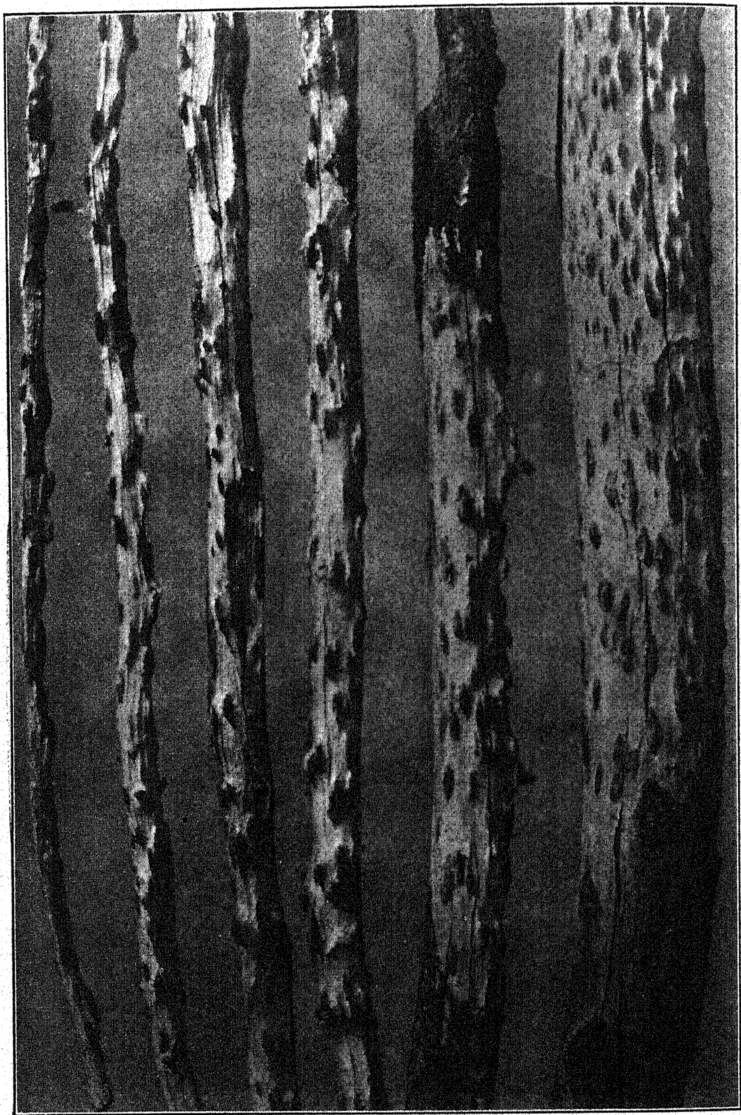

FIG. 2. Decorticated twigs showing numerous stromatic nodules.

from 600–1000 × 3μ, and at maturity they are faintly bluish, less mature specimens being hyaline (*pl. 31, f. 6*). They are multiseptate, generally curved or twisted, and each locule is twice as long as wide. The paraphyses, which are abundantly present, are unbranched, non-septate, and about one-third the width of the spores (*pl. 31, f. 7*).

GEOGRAPHICAL DISTRIBUTION

The mountain cedar is commonly present on the limestone slopes and hills throughout central, southwestern, and western Texas, and extends south into Mexico. In all probability the range of the fungus is co-extensive with the distribution of the mountain cedar. The disease has been observed to be present wherever the cedar occurs in the territory within a radius of one hundred miles of San Antonio.

EFFECT ON THE HOST

That the fungus is parasitic is very probable. It occurs most abundantly on the younger twigs and young trees, especially where there is more or less shading, such as occurs when the trees grow in dense brakes. The lowermost branches in such brakes are generally dry and covered with the whitish areas. The shading has only served to render the branches more susceptible to the attacks. The affected branches are not killed until the fungus surrounds them completely, corrodes the bark, and destroys the cambium layer. The corrosion of the dead branches may then continue and leave the protruding perithecial nodules as previously mentioned. Very frequently, entire trees of various ages or many of the branches are dead and whitened, apparently as a result of the inroads of the fungus.

TECHNICAL DESCRIPTION

Cyanospora gen. nov.

Peritheciis solitariis vel saepe duobus, raro tribus, pustulis cortici vel ligno immersis, horizontalibus, elongatis in eadem via quam axe stromatis, ostiolis lateralibus, leviter pertusis. Ascis gracilibus, linearibus, in matrici glutinosa, membranis internis apicis incrassatis, basi ruptis. Sporidiis filiformibus, pleuriseptatis, hyalinis.

FIG. 3. Pieces of bark from living branches showing the white granular patches with numerous stromatic nodules.

Cyanospora Albicedrae sp. nov.

Stromatibus corticis vel ligni in areis dealbatis in cortice vel lignis ramorum decorticatis. Stromatibus corticis griseis; stromatibus ligni plerumque nigrioribus, saepe atris, lignis corrodatis. Pustulis omnibus plus vel minus lenticularibus, 1–2 mm. longis, plerumque solitariis vel 2–3 coacervatis. Peritheciis 1–3 in quoque stromate, saepius solitariis, 825–1200 × 260–400μ, horizontalibus, elongatis in ipsa via quam axe stromatis, membranis tenuissimis, ligno vel cortice omnino immersis, ostiolo verso, leviter attenuato. Ascis gracilaribus, cylindraceis, 700–1100 × 8–10μ, 6–8-sporis, base attenuata, membrana interna apice incrassata, obtusis. Ascis maturatibus supra basem ruptis liberatisque cum sporis exsertis, omnino strato glutinoso circumdatis. Paraphysibus multis, simplicibus, continuis, 1μ diam. Sporidiis numquam rectis, plerumque curvulis vel contortis, pleuriseptatis, 600–1000 × 3μ, hyalinis vel cyanophyceis, loculis leviter longioribus quam latis.

Hab. In cortice vel decorticato ligno *Sabinae sabinoidis* viventis.

RELATIONSHIP.

This genus is apparently to be referred to the Ceratostomaceae, being perhaps most closely related to *Ophioceras,* from which it differs in several respects. The most important of these are shown in the following tabulation:

	Cyanospora	*Ophioceras*
Perithecia	horizontal	erect
	in stromatic nodules	not in stromatic nodules
	solitary or 2–3	solitary
Ostiolum	very short	elongated
Asci	thickened at apex	not thickened
	in gelatinous matrix	gelatinous matrix absent
Spores	very long	long

This indicates differences which would seem to be worthy of generic rank.

SCHOOL OF BOTANY,
UNIVERSITY OF TEXAS,
AUSTIN, TEXAS.

EXPLANATION OF PLATE XXXI (frontispiece)

Fig. 1. Nodules from decorticated branches. (Length of entire scale 1 mm.)

Fig. 2. Nodules as they appear on the bark, showing the difference in size and form as compared with the wood nodules. (To the right of the scale.)

Fig. 3. Diagram of a longitudinal section of a nodule, cutting through a perithecium. × 28.

Fig. 4. Diagrammatic longi-section of a nodule and perithecium with the asci and spores extruded. × 28.

Fig. 5. Upper portion of a spore-sac showing the thickened apical wall and the coiled spores projecting beyond the broken basal end. × 360.

Fig. 6. A single filamentous spore. × 360.

Fig. 7. A fragment of a spore and paraphysis. × 720.

CULTURES OF UREDINEAE IN 1909[1]

J. C. Arthur

The year 1909 marks the beginning of the second decade of culture work by the writer. The present report is preceded by nine other similar reports[2] covering work done between 1899 and 1908 inclusive, each issued annually except the second one, which covered two years. The following account of the work for the year 1909 is divided into a general introductory part, a list of negative results, in which the sowing of the spores did not bring hoped-for infection but the record seemed worth preserving for use in directing future work, and a list of positive results, in which the sowing of spores caused an infection that gave rise to characteristic fruiting bodies. The successful sowings largely belonged to species previously cultivated, and are recorded to verify or amplify existing knowledge. A small number of successful sowings were made with species never before cultivated, and whose alternate forms had never before been associated.

The work of the year was carried on under adverse and trying conditions. A new building for the experiment station was begun in the previous autumn, and was located upon the ground where for many years a great variety of plants has been grown, especially brought together for this work. It was in effect a small botanical garden filled with plants from all over the continent known to serve as hosts for different species of rusts, and from which plants were in large part drawn for the cultures. As many plants as possible were removed to another plot of ground some distance away, but many species were wholly lost. The seedlings of self-sown annuals were especially missed in providing potted plants for the spring's work. The heavy infectional work had only begun in April when it became necessary to abandon the greenhouses where the work was in progress, so they

[1] Read before the Botanical Society of America at the Boston meeting, December 29, 1909.

[2] See Bot. Gaz. **29**: 268–276, **35**: 10–23; Jour. Myc. **8**: 51–56, **10**: 8–21, **11**: 50–67, **12**: 11–27, **13**: 189–205, **14**: 7–26; and Mycol. **1**: 225–256.

could be wrecked. The temporary quarters provided in another greenhouse were scarcely in working order before another move was necessary. This time a hastily constructed glass lean-to, placed on the east side of a frame building, was made from the wreckage of the two demolished houses. Good conditions for securing infection could not be uniformly maintained. Not only was the practical part of the work hampered in this manner, but the time required in designing the botanical rooms and furnishings for the new experiment station, making temporary adjustments in the old quarters, and finally moving into the new building, seriously interfered with the correspondence and the excursions by which material and information are brought together for making cultures of untried species.

The chief excursion of the year was made by Mr. F. D. Kern and the writer to South Carolina, with incidental stops in Tennessee and North Carolina. It occupied a week during the middle of March. The first stop was at Knoxville, Tenn., where Prof. S. M. Bain, of the University of Tennessee, courteously aided us in every way possible. Upon our return journey we spent a day at Asheville, N. C. At both places culture material was secured. The trip was especially planned, however, to visit the localities made famous to mycologists by the very important contributions of H. W. Ravenel.

Mr. Ravenel belonged to a distinguished southern family, whose estate lay some miles north of Charleston on the Santee Canal, a water way long since fallen into disuse. It was here that he obtained the material for the five centuries of his Fungi Caroliniani Exsiccati, issued during the decade preceding the Civil War. Nearly two days were spent most profitably in this locality. Our work was much facilitated by the intelligent interest of Mr. Octavus Cohen of Monks Corners, the nearest railway town, although not himself a botanist. We were desirous, among other things, to rediscover and identify the uncertain rust from the trunks of cedar trees, issued as no. 87 in the fifth century of the Fungi Caroliniani, under the name *Gymnosporangium Juniperi.* We were not only able to do this, deciding that it belongs to the multiform species, *G. nidus-avis,* and not to the one whose name it bears, but in addition we found two hith-

erto undetected species of the same genus, also inhabiting the red cedar, as well as other culture material. The locality is an interesting one, and deserving of further uredinological exploration.

We spent two days at Aiken, in the highlands of South Carolina, where Mr. Ravenel lived after the Civil War had swept away the family wealth. It was here that the work on his Fungi Americani Exsiccati was done. We wished especially to obtain further knowledge of *Roestelia hyalina*, a highly characteristic rust on *Crataegus* which is only known from Ravenel's original collection made at Aiken and distributed in 1878 as no. 37 in his Fungi Americani. We hoped to find a telial form from which the *Roestelia* could be grown, as we had done last year in the similar case of an isolated *Roestelia* from central Kentucky.[3] Unfortunately we failed to obtain any trace of the sought for rust, although we secured other culture material.

During the week following my associate, Mr. Kern, joined a company from the Missouri Botanical Garden at St. Louis, in a day's collecting along the bluffs of the Mississippi River south of St. Louis, securing culture material chiefly of grass and sedge rusts.

Another brief but important trip was made by Mr. Kern the first week in June to Leland in the northern part of the southern peninsula of Michigan, about 300 miles north of Lafayette, Ind. This was in consequence of observations made by Mr. Kern and the writer in that locality during the previous September. Horn-like aecia on *Sorbus*, *Aronia* and *Amelanchier* are quite common in the northern United States and Canada, and often occur in herbaria, usually under the name *Roestelia cornuta*. Morphological studies made by Mr. Kern convinced him some time ago that the similar aecia on the three host genera belong to three independent species of rusts, and since then we have been trying to secure suitable material for cultures. Last year we were able to show that telia of *Gymnosporangium cornutum* on the branches of *Juniperus Sibirica* produced the aecia on *Sorbus*, and that telia of *G. Davisii* on the leaves of the same host produced the aecia on *Aronia*.[4] In searching in northern Michigan for clues

[3] Mycol. 1: 226. 1909.

[4] Mycol. 1: 240–242. 1909.

to the *Amelanchier* form we most fortunately found a very small weather-beaten plant of *Amelanchier* not over six or eight inches high, bearing at the time about a score of leaves, and every leaf thickly covered with the characteristic horn-like aecia. No other plants of *Amelanchier* infected with the same sort of aecia could be found in the region, although they often bore aecia of other species. The plant in question did not occur near *Juniperus Sibirica,* although that juniper was very common, but much to our surprise was associated with *Juniperus horizontalis*, a trailing form of the red cedar, that produces circular mats up to fifty feet in diameter and rises only three to five inches from the ground. No other form of red cedar occurs in the region, and even this one is not abundant. In the midst of one of these red cedar mats, some six feet in diameter, we found on September 7 the heavily infected *Amelanchier* just mentioned. It was too late in the season to hope to find telia. We did, however, detect some remains of what appeared to be telial galls on the larger branches close to the infected *Amelanchier,* from which the aecia might have been derived. It was to ascertain if telia subsequently developed on this particular red cedar, and, if so, to secure some for cultures, that Mr. Kern again visited Leland. The highly satisfactory results of the trip are given later in this paper under the report of cultures of species never before recorded.

In this connection an error in the report of cultures for 1908 should be pointed out. The record of *Gymnosporangium Davisii* Kern,[5] should have been listed among "Successful cultures reported for the first time." Studies have since shown that the form grown by Dr. Ed. Fischer of Bern, Switzerland, and which he subsequently named *G. Amelanchieris* is quite distinct from *G. Davisii*. The aecial host of the European form is a true *Amelanchier* (service-berry), and not an *Aronia* (choke-berry). The assumption that it was an *Aronia,* a genus not represented in the Swiss flora, came from confusion in interpreting the synonymy. The very similar aecia on *Amelanchier* in America produce a gall on the stems of the red cedar ,as the present season's work has demonstrated, while the aecia on *Amelanchier* in Europe produce small sori on the leaves of the common juniper. The

[5] Mycol. 1: 241–242. 1909.

whole paragraph beginning with the third line on page 242 of the last season's report is largely irrelevant, and should be stricken out.

Most of the experimental part of the culture work of each year is done in the spring, and while in progress it wholly absorbs the time of one person in addition to that of the regular workers in the department. This year Miss Louise M. Falk, of Davenport, Iowa, a senior honor student in the University of Iowa, was recommended for the position by Professor Thomas H. Macbride. Miss Falk was in charge of the work from April 1 to June 3. She showed great enthusiasm and assiduity in conducting the cultures, although the turmoil of building and moving put the possibility of entirely satisfactory manipulation out of the question, as well as introduced most annoying interference. As for the year or two past, most of the cedar rust cultures were made by Mr. Kern. The investigations as a whole are a part of the work conducted by the botanical department of the Indiana Experiment Station, and are financed from the Adams fund appropriated by the general government for scientific research.

Those who assisted this year by supplying culture material and communicating field observations are most gratefully mentioned. Mr. E. Bethel, Denver, Colo., heads the list with forty-six collections of culture material. Messrs. J. F. Brenckle, Kulm, N. D., J. M. Bates, Red Cloud, Neb., and W. P. Fraser, Pictou, Nova Scotia, each sent between twenty and thirty collections, while a much smaller number was sent by Messrs. O. E. White, Brookings, S. D., A. O. Garrett, Salt Lake City, Utah, C. F. Baker, Claremont, Calif., J. J. Davis, Racine, Wis., E. Bartholomew, Stockton, Kans., E. W. Olive, Brookings, S. D., John L. Sheldon, Morgantown, W. Va., F. D. Heald, Austin, Texas, H. W. Barre, Clemson College, S. C., W. P. Kelley, Honolulu, Hawaii, F. E. Lloyd, Zacatecas, Mex., Aven Nelson, Laramie, Wyo., F. L. Stevens, West Raleigh, N. C., and Guy W. Wilson, Fayette, Iowa. Plants for particular culture work were sent by Dr. William Trelease, of the Missouri Botanical Garden, St. Louis, Mo. Thanks are extended to the above individuals, and to others who aided in the year's investigations.

During the present season 178 collections of material with resting spores and 18 collections with active spores were employed, from which 684 drop cultures were made to test the germinating condition of the spores. Out of the 178 collections with resting spores 95 could not be brought to germination, leaving 83 collections of available material to serve for the projected cultures. These 83 collections with resting spores and 18 with active spores belonged to about 70 species of rusts. Altogether 345 sowings were made, employing for the purpose 97 species of hosts, these being grown in pots.

The results of this work are given in the following paragraphs, and are divided into negative results, positive results with species whose life cycles have already been ascertained by the writer or other investigators, and positive results with species whose life cycles are now first completed and placed on record.

NEGATIVE RESULTS:—Quite a number of collections gave good germination of the spores, and these were sown on plants in the hope of discovering the alternate host, but no infections were secured. The following may be recorded to serve for reference in future studies, although not so much importance can be attached to these results as in former years, owing to unsatisfactory conditions, as stated above:

1. PUCCINIA on *Carex tenella* Schk., collected at Pictou, Nova Scotia, by Prof. W. P. Fraser, was sown on *Boehmeria cylindrica, Apocynum cannabinum, Lepargyraea canadensis, Symphoricarpos pauciflorus, Rudbeckia laciniata* and *Iva frutescens*, with no infection.

2. PUCCINIA on *Carex tenuis* Rudge, collected at Pictou, Nova Scotia, by Prof. W. P. Fraser, was sown on *Aster paniculatus, Solidago canadensis, Erigeron annuus, Onagra biennis* and *Ambrosia trifida*, with no infection.

3. PUCCINIA on *Carex Bonplandii minor* Vasey, collected at Granby, Colo., by Mr. E. Bethel, was sown on *Aster Tweedii, A. paniculatus, A. multiflorus* and *A. Drummondii*, with no infection. The determination of the host was made by Mr. Theo. Holm.

4. PUCCINIA on *Carex Backii* Boott, collected in Colorado, by

Mr. E. Bethel, was sown on *Lactuca sativa, Artemisia dracunculoides, Ambrosia trifida, Grindelia squarrosa* and *Laciniaria spicata,* with no infection. The determination of the host was made by Mr. Theo. Holm.

5. PUCCINIA on *Carex siccata* Dewey, collected at Kulm, N. D., by Dr. J. F. Brenckle, was sown on *Ambrosia trifida* and *Carduus undulatus,* with no infection.

6. PUCCINIA RUBIGO-VERA Auct., on *Hordeum jubatum,* collected at Brookings, S. D., by Mr. O. E. White, was sown on *Lycopsis arvensis* (on 3 different dates), *Heliotropium curassavicum* (on 3 dates), *Myosotis palustris* (3 dates), *Lithospermum canescens, L. arvense, L. angustifolium, Hydrophyllum virginicum, Ceanothus americanus, Callirrhoe involucrata, Symphoricarpos racemosus, Petalostemon purpurpeum, Laciniaria punctata* and *Ambrosia trifida,* with no infection.

7. PUCCINIA DISTICHLIDIS E. & E., on *Spartina gracilis* Trin., collected at Kulm, N. D., by Dr. J. F. Brenckle, was sown on *Lepargyraea canadensis, Mimulus ringens, Symphoricarpos recemosus, Polygala Senega, Grindelia squarrosa* and *Carduus undulatus,* with no infection.

8. PUCCINIA SUBSTERILIS E. & E., on *Stipa viridula* Trin., collected at Eldorado Springs, Colo., by Mr. E. Bethel, was sown on *Tithymalis arkansanus coloradensis, Arabis Holboellii, Grindelia squarrosa* and *Eupatorium serotinum,* while another collection with same data was sown on *Viola sororia, Mimulus ringens, Myosotis palustris, Aster ericoides* and *A. multiflorus,* all with no infection.

9. PUCCINIA STRIATULA Peck, on *Calamagrostis canadensis* (Michx.) Beauv., collected at Wind Lake, Wis., by Dr. J. J. Davis, was sown on *Thalictrum alpinum, T. dioicum, T. purpurascens, Actaea alba, Phacelia bipinnatifida, Hydrophyllum virginicum* and *Polygonatum biflorum,* with no infection.

10. PUCCINIA VIRGATA Ellis & Ev., on *Chrysopogon avenaceus* (Michx.) Benth., collected at Asheville, N. C., by Mr. F. D. Kern, was sown on *Dirca palustris, Viola sororia, Hydrophyllum virginicum, Mimulus ringens, Chelone glabra, Symphoricarpos pauciflorus* and *Ambrosia trifida,* with no infection. Similar

material from Nebraska was sown two years ago on four other species of hosts.[6]

11. PUCCINIA ELLISIANA Thüm., on *Andropogon scoparius* Michx., collected at Ayr, Neb., by Rev. J. M. Bates, was sown on *Ceanothus americanus, Aesculus glabra, Lepargyraea canadensis, Symphoricarpos racemosus, Mimulus ringens, Laciniaria punctata, Lithospermum angustifolium, Chelone glabra, Ranunculus septentrionalis* and *Mertensia virginica*.

Another collection on the same host and by the same collector from Scotia, Neb., was sown on the first six hosts mentioned, and also on *Laciniaria spicata, L. scariosa, Cassia Chamaecrista, Hydrophyllum virginicum, Polygala Senega, Petalostemon purpureum* and *Phacelia bipinnatifida*.

The same species of rust on *A. glomeratus* (Walt.) B.S.P., collected at Asheville, N. C., by Mr. F. D. Kern, was sown on *Cassia Chamaecrista, Lepargyraea canadensis* and *Petalostemon purpureum*, as in the preceding cases, and also on *Baptisia tinctoria, Abronia fragans* and *Viola cucullata*.

The results were uniformly negative, there being no infection. In the two preceding years this rust was sown on nineteen other species of hosts.[7]

12. UROMYCES GRAMINICOLA Burr., on *Panicum virgatum* L., collected at St. Paul, Neb., by Rev. J. M. Bates, was sown on *Callirrhoe involucrata, Althaea rosea, Hibiscus militaris, Sidalcea oregana* and *Viola cucullata*, with no infection. Similar material was sown last year on four of these same hosts, and on four other species without effect.[8]

13. UROMYCES JUNCI (Desm.) Tul., on *Juncus Balticus* Willd., collected at Kulm, N. D., by Dr. J. F. Brenckle, was sown on *Pulicaria dysenterica*, with no infection. Another collection on the same host from Colorado, sent by Mr. E. Bethel, was sown on *Pulicaria dysenterica*, both seedlings and strong shoots, and on *Grindelia squarrosa* and *Arnica* sp., with no infection. In 1907 a similar collection from Nebraska was sown on fifteen other species of hosts.[9] This common American rust is usually

[6] See Jour. Myc. 14: 10. 1908.
[7] Jour. Myc. 14: 10. 1908; Mycol. 1: 231. 1909.
[8] Mycol. 1: 232. 1909.
[9] See Jour. Myc. 14: 12. 1908.

considered to be the same as the one in Europe from which it takes its name. The experiments of Fuckel, Plowright, and E. Fischer have shown that the European form produces aecia on *Pulicaria dysenterica,* and the failure of the American form to do so may mean that the two are distinct species, or that there are physiological races on different hosts. Further studies are necessary to decide the question.

14. UROMYCES ACUMINATUS Arth., on *Spartina cynosuroides* Willd., collected at Fayette, Iowa, by Prof. Guy West Wilson, was sown on *Steironema ciliatum, S. lanceolatum* and *Polemonium reptans,* with no infection. Similar material from northern Indiana has been sown in previous years on six other hosts, and also four times on *Steironema ciliatum* and two times on *S. lanceolatum,* without infection.[10]

Some years ago in a morphological study of all collections of *Uromyces* on *Spartina* then available the writer decided[11] that the form from the salt marshes of the Atlantic coast, known under the name *U. Spartinae* Farl., having somewhat larger teliospores and urediniospores, the former with more rounded apices, and the latter with thicker walls, than the western form mentioned above, occurred also in the interior of the continent, and could not be clearly separated from *U. acuminatus.* Recently my associate, Mr. F. D. Kern, has restudied the two forms, with all the data that have accumulated in the decade since my own study was completed, and is able to supplement the morphological differences which I pointed out with others, and concludes that the two forms represent distinct species. He gives the distribution of *U. acuminatus* as the wet, alluvial prairies of Iowa, Minnesota, and adjoining states, extending eastward to northern Indiana, while *U. Spartinae* is found in saline soils from Alberta southwestward to Wisconsin and Kansas, and along the Atlantic coast from Nova Scotia to Florida. Reexamining the successful cultures with *Uromyces* on *Spartina,* made in 1905 and 1907, the material for which was sent from western Nebraska,[12] it is found that the culture material agrees with *U. Spartinae* Farl. Putting all the data together, the writer's suspicions, recorded

[10] See Jour. Myc. 10: 9. 1904; 13: 193. 1907.

[11] Bot. Gaz. 34: 3. 1902.

[12] Jour. Myc. 12: 24. 1906; and 14: 17. 1908.

both in the discussion of his morphological studies and his cultural reports, cited above, that there are two species of *Uromyces* on *Spartina,* are confirmed. The aecial form of *U. Spartinae* Farl. occurs on *Steironema ciliatum* and *S. lanceolatum,* and the aecial form of *U. acuminatus* Arth. is yet unknown, although field observations made by Mr. Guy West Wilson indicate that it may occur on *Polemonium reptans.*

15. GYMNOSPORANGIUM sp., on *Juniperus virginiana* L. collected at the Santee Canal, near Monks Corners, S. C., by Mr. F. D. Kern, was sown March 24 on the leaves of *Crataegus punctata, Amelanchier erecta,* and *Cydonia vulgaris,* with no infection. On April 1 it was sown again on the same three species and on *Malus coronaria,* with no infection. It was sown again April 14 on *Crataegus* sp., and *Malus Malus,* still with no infection. On April 26 a sowing was made on *Crataegus coccinea* and *Pyrus communis* (Kiefer's Hybrid), and on May 14 a further sowing on *Crataegus cerronis, Aronia arbutifolia, Sorbus americana* and *Porteranthus stipulatus,* wholly without infection.

The failure to secure infection, although sowings were made on all the genera known to harbor aecia of the *Gymnosporangia* in the eastern United States, was probably due to the maturity of the leaves, or to some accident. It is certain on morphological grounds that this cedar rust is not a form at present recognized under established names. The rust produces large brown sori, often in series, extending along the bark of the larger branches. It has somewhat the general appearance of *Gym. nidus-avis,* causes a similar swelling of the branches, but differs in having prominently projecting sori, even before gelatinization, which are much roughened on the surface.

SUCCESSFUL CULTURES SUPPLEMENTING PREVIOUS WORK: The following species of rust were successfully grown and the facts supplement those obtained from previous cultures in this series or those recorded by other American or European investigators. In a number of cases the data here presented materially extend the previously available knowledge regarding the several species.

1. PUCCINIA PECKII (DeT.) Kellerm., on *Carex lanuginosa* Michx., collected at Red Cloud, Neb., by Rev. J. M. Bates, was

sown May 19 on *Sambucus canadensis* and *Onagra biennis,* giving no infection on the former, but giving very abundant pycnia on the latter May 28, followed by aecia June 6.

Four collections on the same host, made by Dr. J. F. Brenckle, at Kulm, N. D., were used for three successful sowings on *Onagra biennis,* giving rise to pycnia in seven to twelve days, followed by aecia in five to seven days more. Sowings on *Gaura biennis* and *Carduus undulatus* gave no infection.

A collection on *Carex trichocarpa* Muhl., made by Mr. F. D. Kern at White House, St. Louis Co., Mo., after having been sown on *Sambucus canadensis* with no infection, was sown April 21 on *Gaura biennis,* giving rise to pycnia April 30, and aecia May 10.[13]

2. PUCCINIA CARICIS (Schum.) Schröt., on *Carex aristata* R. Br., collected at Kulm, N. D., by Dr. J. F. Brenckle, was sown April 6 on *Urtica gracilis,* giving rise to pycnia April 13 and aecia April 17, both in great abundance. A similar sowing April 21 on *Boehmeria cylindrica* gave no infection. Another sowing May 4 on both hosts gave no infection on *Boehmeria cylindrica,* but produced the richest possible infection on *Urtica gracilis,* showing pycnia May 9, and aecia May 15. Beside adding another species of *Carex* to the list of hosts supplying culture material for this rust,[14] the results indicate that *Boehmeria* is not an aecial host.

It may be well to point out in this connection that the usual citation of Rebentisch for this species of rust is erroneous. This author in his Florae Neomarchicae, 1804, page 356, describes *Puccinia Caricis* as a new species in the following words: "*Sparsa minutissima punctiformis, capsulis cylindraceis apice utrinque attenuatis. In foliis Caricis praecocis Jacq.*" Only the one host species is named, neither the description nor the host tally with those known to belong to the rust having its aecia on *Urtica,* as may be seen by consulting Sydow's Monographia Uredinearum. They, however, do agree well with those given by Sydow under *Puccinia silvatica,* to which species Rebentisch's name should doubtless be referred.

[13] For previous cultures see Bot. Gaz. 35: 13. 1903; Jour. Myc. 8: 55. 1902; 11: 58. 1905; 12: 15. 1906; 13: 195. 1907; and Mycol. 1: 233. 1909.

[14] For previous cultures see Bot. Gaz. 29: 270. 1900; 35: 16. 1903; Jour. Myc. 8: 52. 1902; 12: 15. 1906; and 14: 14. 1908.

3. PUCCINIA UNIVERSALIS Arth., on *Carex stenophylla* Wahl., collected at Eldorado Springs, Colo., by Mr. E. Bethel, was sown April 26 on *Arabis Holboelli, Sambucus canadensis, Urtica gracilis* and *Artemisia dracunculoides.* All remained free from infection except the last, on which pycnia appeared May 5, and aecia May 14. This is a confirmation of the result obtained in 1907.[15] In making the cultures and writing up the results of that year it was overlooked that the combination which was then established had been repeatedly suggested by Rev. J. M. Bates. In the spring of 1906 Rev. Bates sent a collection of rust on *Carex stenophylla,* obtained at Boelus, Neb., on June 25, 1906, and on the packet he wrote that it was associated with aecia on *Artemisia longifolia.* This came too late in the season to be tested by a culture. In a letter received in September of the same year he stated that his field observations made it almost certain that this *Carex* rust and the *Artemisia* aecia were alternate forms of one species. Both my associate, Mr. Kern, and myself were at that time of the opinion that the aecia on *Artemisia* belonged to the telia on the same host, and so firmly did we believe this error that when material for cultures was at hand the following spring, we had forgotten Rev. Bates' suggestion, and we also overlooked the memorandum in our book of suggestions for future work.

4. PUCCINIA CARICIS-ASTERIS Arth., on *Carex festiva* Dewey, the host being determined by Mr. Theo. Holm, collected August 15, 1908, at Granby, Colo., by Mr. E. Bethel, was sown May 17 in accordance with the suggestion of the collector on *Aster adscendens* Lindl. (*A. Tweedyi* Rydb.), giving rise to pycnia which were first noticed May 31, although they may have appeared earlier, and to a few aecia June 6. A sowing was also made at the same time on *Agoseris glauca* with no infection.

Another collection made in the same vicinity five days later was sown May 22 on *Aster adscendens* and produced abundant pycnia May 29, and many aecia June 4. These cultures bring forward a new set of hosts, and show the species to be of wide distribution in America.[16]

[15] See Jour. Myc. 14: 21. 1908.

[16] For previous cultures see Bot. Gaz. 35: 15. 1903; Jour. Myc. 8: 54. 1902; and 14: 13. 1908.

5. PUCCINIA SUBNITENS Diet., on *Distichlis spicata* (L.) Greene, collected at Kulm, N. D., by Dr. J. F. Brenckle, was sown April 23 on *Corydalis aurea* Willd., with no infection, and also on *Atriplex hastata*, giving pycnia May 3, and aecia May 12. Another sowing was made April 24 on *Corydalis sempervirens* (L.) Pers. (*C. glauca* Pursh), with no infection, and also on *Atriplex hastata* and *Chenopodium album*, both of which gave infection, showing pycnia April 31, and aecia later.[17] The chief object in again growing this rust was to see if it would infect species of *Corydalis* on which occur *Aecidium fumariacearum* Kellerm. & Sw. (*A. Corydalis* Webber), the aecia and aeciospores of which resemble those belonging to *Puccinia subnitens*. The results, however, are inconclusive, and further cultures must be attempted before the question can be settled.

6. PUCCINIA AMPHIGENA Diet., on *Calamovilfa longifolia* (Hook.) Hack., collected at Kulm, N. D., by Dr. J. F. Brenckle, was sown May 22 on *Smilax hispida*, and gave numerous pycnia May 31, and aecia June 4. This extends the geographical range from which material has been received for successful cultures.[18]

7. PUCCINIA FRAXINATA (Schw.) Arth., on *Spartina cynosuroides* Willd., collected at Kulm, N. D., by Dr. J. F. Brenckle, was sown May 22 on *Fraxinus lanceolata*, giving rise to pycnia May 29, and aecia June 4.[19]

8. PUCCINIA PHRAGMITIS (Schum.) Körn., on *Phragmites communis* Trin., collected at Scotia, Neb., by Rev. J. M. Bates, was sown May 14 on *Rumex crispus*, giving rise to pycnia May 22, and aecia May 29, both in the greatest abundance. Another collection by the same person, made at Grand Island, Neb., was sown May 17 on *R. crispus*, giving abundance of pycnia May 23, and aecia May 29.[20]

9. PUCCINIA OBLITERATA Arth., on *Agropyron* sp., collected

[17] For previous cultures see Bot. Gaz. 35: 19. 1903; Jour. Myc. 11: 54. 1905; 12: 16. 1906; 13: 197. 1907; 14: 15. 1908; and Mycol. 1: 234. 1909.

[18] For previous cultures see Bot. Gaz. 35: 20. 1903; Jour. Myc. 11: 57. 1905; 12: 16. 1906; and 14: 15. 1908.

[19] For previous cultures see Bot. Gaz. 29: 275. 1900; Jour. Myc. 11: 57. 1905; 12: 16. 1906; 14: 14. 1908; and Mycol. 1: 236. 1909.

[20] For previous cultures see Bot. Gaz. 29: 269. 1900; Jour. Myc. 9: 220. 1903; and 14: 15. 1908.

August 15, 1908, at Granby, Colo., by Mr. E. Bethel, was sown April 21 on *Thalictrum alpinum* and *T. dioicum*. There was no infection on the latter host, but on the former it was abundant, showing aecia May 6. Pycnia were so scantily produced that it required an extended search, aided with sections from the affected spots to discover any. A careful morphological study reveals no difference between the telial material used for this culture together with the aecia produced by it, and the telial material on the same host used last year, together with the aecia then produced on *Aquilegia*.[21] The gross appearance of the infected areas, the manner of the hypertrophy, and the remarkable paucity of pycnia, also combine to indicate that the two cultures belong to one species, although the production of aecia on both *Thalictrum* and *Aquilegia* by a single species is not in accordance with similar studies made in Europe.[22]

10. PUCCINIA MUHLENBERGIAE Arth. & Holw., on *Muhlenbergia glomerata* Trin., collected at Stockton, Kans., by Mr. E. Bartholomew, was sown May 17 on two plants of *Callirrhoe involucrata*, both giving rise to numerous pycnia May 31, and to aecia June 6 in one case and June 12 in the other. At the same time it was sown on *Napaea dioica*, *Althaea rosea* and *Sidalcea* sp., with no infection. These hosts are known to bear aecia of the same appearance and morphological structure as those secured by the culture on *Callirrhoe*, and the reason why they were not affected by the sowings is not clear, unless this species of rust is made up of races.[23]

11. PUCCINIA IMPATIENTIS (Schw.) Arth., on *Elymus striatus* Willd., collected at Lafayette, Ind., by Mr. A. G. Johnson, was sown May 6 on *Napaea dioica*, with no infection, and at the same time on *Impatiens aurea*, giving rise to pycnia May 15, and aecia in abundance May 25. Another collection on the same host, made by Mr. F. D. Kern at White House, St. Louis Co., Mo., was sown May 11 on *I. aurea*, producing pycnia May 21, and aecia May 29. It was also sown at the same time and produced no infection on *Napaea dioica*, *Callirrhoe involucrata*, *Thalictrum*

[21] See Mycol. 1: 250. 1909.

[22] See Klebahn, Wirtsw. Rostpilze 275, 276. 1904.

[23] For previous cultures see Mycol. 1: 251. 1909.

dioicum, Actaea alba, Caulophyllum thalictroides, Boehmeria cylindrica, Myosotis palustris, Mimulus ringens, Polemonium reptans, Hydrophyllum virginicum, Polygala Senega, Dirca palustris, Psoralea Onobrychis and *Ipomoea pandurata.*

Aeciospores from *Impatiens aurea* Muhl., were sown on three species of *Elymus.* For this purpose small plants bearing aecia were taken from the field, where they grew close together, and had presumably received infection from one source. These were established in pots, and the pots adjusted over the plants of *Elymus* to be infected, so the spores would drop of themselves upon the leaves of the grass, belljars being used as usual to secure the right degree of moisture for the germination of the spores. In this manner aeciospores were sown June 4 upon *Elymus virginicus* L., *E. canadensis* L. and *E. striatus* Willd. In all three cases uredinia began to show June 17, and continued to increase for some time, but the conditions were not such as to keep the plants in healthy condition for the maturing of telia.

Former cultures[24] had demonstrated the genetic connection between the aecia on *Impatiens* and telia on Elymus virginicus. The present season's work indicates that the rust on all species of *Elymus* in the region east of the Rocky Mountains belongs to one species, *Puccinia Impatientis.*

12. PUCCINIA POCULIFORMIS (Jacq.) Wettst., on *Agropyron pseudorepens* Scribn. & Sm., collected at Kulm, N. D., by Dr. J. F. Brenckle, was sown May 4 on *Berberis vulgaris,* giving rise to pycnia May 12, and numerous aecia May 24. Another collection on *Sitanion longifolium* J. G. Sm., made at Tolland, Colo., 9,000 feet altitude, by Mr. E. Bethel, was sown May 17 on *Berberis vulgaris,* and gave pycnia May 29, but owing to maturity of the leaves did not reach the production of aecia. Still another collection on *Sitanion longifolium,* made at Eldorado Springs, Colo., 4,500 feet altitude, by Mr. E. Bethel, was sown April 26 on *Berberis vulgaris,* and gave pycnia May 3, and aecia May 12, both in great abundance. On May 17 the barberry plant bearing aecia, produced in the last culture, was arranged over a pot in which young wheat plants (*Triticum vulgare* Vill.) were growing, in such a manner that the aeciospores could fall

[24] See Bot. Gaz. 35: 18. 1903; Jour. Myc. 10: 11. 1904; and 11: 57. 1905.

upon the wheat leaves. On May 29 urediniospores began to show, and their abundance increased for some time, but owing to the lateness of the season the wheat plants did not flourish, and in consequence teliospores were not formed.

This species of rust, which is the most injurious cereal rust known, is very common throughout the country, not only on cereals, but on many wild grasses. It has now been grown[25] in our series of cultures from telia on *Agropyron repens* from Vermont, *A. tenerum* from Iowa and Nebraska, *Agrostis alba* from Indiana and New York, *Cinna arundinacea* from Indiana, *Elymus canadensis* from Iowa and Wisconsin, and the two hosts mentioned above. In 1907 the aeciospores raised from telia on *Agrostis alba* obtained in Indiana were used to produce infection on wheat (*Triticum vulgare*) and barley (*Hordeum vulgare*), and in 1908 aeciospores raised from telia on *Agropyron tenerum* obtained in Nebraska were used for infection on oats (*Avena sativa*). This year the aeciospores raised from telia on *Sitanion longifolium* obtained in Colorado produced infection on wheat. More extended work is planned in regard to the problem of the transfer of this pernicious black or stem rust from wild grasses to the cultivated cereals, but enough has been accomplished to warrant the statement that although in the uredinial stage this rust shows racial strains that inhibit the ready transfer from one species of host to another, as has been shown by many European and American investigators, yet in the aecial stage racial strains play no part, and the barberry acts as a bridging host between each and every other gramineous host.

13. PUCCINIA SUBSTERILIS E. & E., on *Stipa viridula* Trin., collected April 16 at Eldorado Springs, Colo., by Mr. E. Bethel, bore abundance of amphispores, which were sown April 29 on plants of *Stipa viridula*, and gave rise to urediniospores in abundance, first observed May 24. A sowing at the same time on *Stipa spartea* gave no infection.

14. UROMYCES ANDROPOGONIS Tracy, on *Andropogon virginicus* L., collected at Morgantown, W. Va., by Dr. John L. Sheldon was sown June 4 on *Viola cucullata*, giving ten groups of pycnia,

[25] For previous cultures see Jour. Myc. 8: 53. 1902; 11: 57. 1905; 12: 17. 1906; 13: 198. 1907; and 14: 16. 1908.

first showing June 12. The leaves matured so rapidly that no aecia were formed. A sowing at the same date on *Viola primulifolia* gave no infection. This species of rust has been grown upon *Viola* by Dr. John L. Sheldon,[26] but previous attempts made in my own laboratory have failed.[27] The reason for the failures seems to be the tardiness in making the cultures, by which the violet leaves are too mature and ripen so rapidly that infection is not secured. I am indebted to Dr. Sheldon for the suggestions, field observations and culture material, which have enabled me to add this species to the list of completed life cycles.

15. UROMYCES SPARTINAE Farl., on *Spartina cynosuroides* Willd. collected at Kulm, N. D., by Dr. J. F. Brenckle, was sown April 23 on *Lysimachia quadrifolia,* with no infection, and at the same date on *Steironema ciliatum* and *S. lanceolatum,* giving rise to pycnia May 5 on the former and May 8 on the latter. In both cases growth did not extend to the formation of aecia owing to the feeble condition of the host plants.[28] The confusion of this species of rust with *Uromyces acuminatus* Arth. has already been discussed above among unsuccessful cultures.

16. GYMNOSPORANGIUM GLOBOSUM Farl., on *Juniperus virginiana* L., collected at Asheville, N. C., by Mr. F. D. Kern, was sown May 15 on *Malus Ioensis, Crataegus punctata* and *C. coccinea,* with no infection on the first and second, but on the last giving rise to pycnia May 25 in abundance, followed by aecia which were mature July 26.[29]

17. GYMNOSPORANGIUM CLAVIPES C. & P., on *Juniperus sibirica* Burgsd., collected at Leland, Mich., by Mr. F. D. Kern, was sown June 5 on the fruit of *Amelanchier erecta,* giving rise to pycnia June 14, and to mature aecia August 3, both in abundance. At the same time it was sown on the leaves of *Crataegus punctata,* giving rise to numerous pycnia, but as the plant was not well established further development was soon checked.[30] There ap-

[26] Torreya 9: 55. 1909.

[27] See Mycol. 1: 232. 1909.

[28] For previous cultures see Jour. Myc. 12: 24. 1906; and 14: 17. 1908, under the name *U. acuminatus.*

[29] For previous cultures see Jour. Myc. 13: 200. 1907; 14: 18. 1908; and Mycol. 1: 239. 1909.

[30] For previous cultures see Jour. Myc 14: 18. 1908; and Mycol. 1: 239. 1909.

pears to be no noticeable difference between the pycnia and aecia grown this year from telia on the true juniper and those grown last year from telia on the true cedar, thus confirming the unique character of this species of rust in growing upon hosts of the two quite distinct sections of the genus *Juniperus.*

18. GYMNOSPORANGIUM NIDUS-AVIS Thax. on *Juniperus virginiana* L., collected at Asheville, N. C., by the writer, was sown March 22 on *Amelanchier canadensis,* without infection, and at the same time on *Crataegus Pringlei* and *Malus Ioensis,* both giving rise to an abundance of pycnia April 6. The infection on *Crataegus* did not perfect aecia, but that on *Malus* matured aecia in abundance by April 27.[31]

The telia of this collection were on the main branches of a tree thirty feet high, and when found were fully expanded. They formed wavy masses standing out two centimeters or more from the bark and extending in long lines of four or five decimeters, like orange colored ruffles or frills. The appearance was that of a large *Tremella,* and so unlike that of any *Gymnosporangium* before seen that not until it was examined under the microscope after returning to Lafayette was it accepted as a rust. It was found that the frills were the consequence of the large sori forming in rows and cracking the bark longitudinally.

19. GYMNOSPORANGIUM BETHELI Kern, on *Juniperus scopulorum* Sarg., collected in Colorado by Mr. E. Bethel, was sown May 14 on *Crataegus cerronis,* and gave rise to pycnia May 22 in abundance, and to first appearance of aecia June 14, the aecia being fully mature August 3.[32]

20. GYMNOSPORANGIUM CORNUTUM (Pers.) Arth., on *Juniperus sibirica* Burgsd., collected at Leland, Mich., by Mr. F. D. Kern, was sown June 5, on *Aronia nigra* and *Amelanchier erecta* with no infection, and at the same time on *Sorbus americana,* giving an abundance of pycnia June 15, but no aecia were formed owing to the weakness of the host plant. Another sowing was made from the same material June 7 on a cutting of *Sorbus aucuparia* placed in water, giving a few pycnia June 18, but the

[31] For previous cultures see Jour. Myc. 14: 19. 1908.

[32] For previous cultures see Jour. Myc. 14: 23. 1908; and Mycol. 1: 240. 1909.

leaves soon died. Still another sowing was made June 14 on *Sorbus americana*, producing numerous pycnia June 26, but the plant gradually died.[33]

21. GYMNOSPORANGIUM FLORIFORME Thax., on *Juniperus virginiana* L., collected at Aiken, S. C., by Mr. F. D. Kern and the writer, was sown March 26 on *Malus Malus* with no infection, and at the same time on *Crataegus coccinea*, giving pycnia in abundance April 12. The after development, however, was very slow, and by the middle of July aecia had only begun to show, and grew so very slowly that they did not reach full size, although observations were continued till November 11. Another sowing from the same material was made May 15 on the same host, resulting in a few pycnia, but no aecia. In both cases the infected leaves matured too rapidly for the very slow growing aecia, and besides, the host used is not a species on which natural infection is likely to occur.

Previous cultures have been made by Dr. R. Thaxter at Cambridge, Mass., and Prof. F. S. Earle at Auburn, Ala. Only a slight notice of these cultures has been published. A description and historical account of the species was recently published by Mr. F. D. Kern.[34] The telial form of the species is very similar in appearance to that of the common *Gym. Juniperi-virginianae*.

22. GYMNOSPORANGIUM EXTERUM Arth. & Kern, on *Juniperus virginiana* L., a living plant a little over six inches high, which has been growing in the greenhouse since being brought from Mammoth Cave, Ky., by Mr. F. D. Kern and the writer a year ago, was sown May 14 on *Porteranthus stipulatus* (*Gillenia stipulacea*), and gave rise to an abundance of pycnia May 22. On June 14 the first aecia appeared, which were mature June 26. The work duplicates and confirms that of last year.[35]

23. CALYPTOSPORA COLUMNARIS (A. & S.) Kühn, on *Vaccinium pennsylvanicum* Lam., collected at Pictou, Nova Scotia, by Prof. W. P. Fraser, was sown June 16 by suspending the moistened stems bearing the rust over potted plants of *Abies Fraseri*. On July 8 abundance of aecia appeared, without being preceded by

[33] For previous cultures see Mycol. 1: 240. 1909.

[34] Bull. Torrey Club 35: 503. 1908.

[35] For previous cultures see Mycol. 1: 253. 1909.

pycnia. European investigators have noted the absence of pycnia in this species, both in the field and in cultures. The suppression of the gametophytic sori, as in this case, is rare in heteroecious rusts.

This is the first culture yet made with American material. In 1880 Hartig made cultures at Munich, Germany, by using aeciospores from *Abies alba* and teliospores from *Vaccinium Vitis-idaea,* thus transferring in both directions.[36] The most extensive cultures were made by Dr. G. Winter in 1885 and 1886, in the garden of the Experiment Station at Halle, Germany.[37] He successfully sowed teliospores on *Abies nobilis, A. magnifica, A. concolor, A. balsamea* and *A. Fraseri,* natives of North America, and on eight other species of *Abies,* natives of various parts of the world.

After the sori made their appearance in our own cultures I wrote to Prof. Fraser, the collector of the culture material, describing the salient characters of the aecia, and inclosed infected leaves obtained by means of the culture. With this information he was able to go into the field and find the aecia on *Abies balsamea,* returning a collection which he made at Pictou, Nova Scotia, July 14, 1909,[38] the first known collection from North America. This stage of the fungus is probably common throughout the country, and the fact that it has been seen but once is doubtless due to its early appearance, lack of accompanying hypertrophy and discoloration, evanescent character, and general inconspicuousness.

SUCCESSFUL CULTURES REPORTED NOW FOR THE FIRST TIME: The following species have never before been cultivated, in America or elsewhere, so far as the writer knows. Although the number is small, it includes most valuable additions to our knowledge of American rusts. The study of the cedar rusts, which has been greatly advanced by the spring excursions of the last three years for personal observation and collection of material, is approaching a full survey of the species of the eastern United States, although an unknown number of species remain in the western mountains yet to be investigated.

[36] See Klebahn, Die wirtsw. Rostpilze 391. 1904.
[37] Hedwigia 26: 28. 1887.
[38] See Fraser, Science 30: 814. 1909.

1. PUCCINIA on *Andropogon Hallii* Hack., collected at Red Cloud, Neb., by Rev. J. M. Bates, was sown June 3 on thirteen species of hosts with no infection, as follows: *Carduus undulatus, Ambrosia trifida, Lithospermum canescens, Myosotis palustris, Hydrophyllum virginicum, Lepargyraea canadensis, Symphoricarpos parviflorum, Napaea dioica, Boehmeria cylindrica, Thalictrum dioicum, Delphinium scaposum, Cassia Chamaecrista* and *Petalostemon purpureus*. The same material was sown the day following on four other species with no infection, viz., *Amorpha nana, Baptisia tinctoria, Psoralea Onobrychis* and *Xanthoxylon americanum*. Each of these hosts is known to harbor aecia whose telial connection has not yet been experimentally ascertained. The material being in unusually good condition an attempt was made to sow it on all unconnected aecial hosts available at the time, hoping in this way to strike the right one, no field clues having been secured. This is a precarious method, but in this instance it succeeded, as among the hosts was included *Ceanothus americanus*, on which a sowing was made June 3, giving rise to numerous pycnia June 12, and an abundance of aecia June 22.

The telial form of this species was first detected by the writer while preparing the material for the third fascicle of Arthur and Holway's Uredineae Exsiccatae, and was referred to *Puccinia Cesatii* Schröt., on account of the similarity of the urediniospores to those of that species.[39] Sydow in his Monograph rightly called this reference in question, and suggested that it might be a new species, but did not give a name or description.[40]

The aecial form of this species was described by Ellis and Kellerman in 1884, under the name *Aecidium Ceanothi*, from a collection made at Manhattan, Kans. The form is not only known from Kansas, but also from Nebraska, and northwestern Wisconsin.

Puccinia Ceanothi (Ellis & Kellerm.) nom. nov. (*Aecidium Ceanothi* Ellis & Kellerm., Bull. Torry Club **11**: 114. 1884.)

O and I. On *Ceanothus ovatus* Desf., Manhattan, Kans., May 20, 1884, *W. A. Kellerman* (type); Rooks Co., Kans., May, 1898,

[39] Bull. Lab. Nat. Hist. Iowa Univ. 5: 181. 1901.

[40] Sydow, Monog. Ured. 1: 723. 1903.

E. Bartholomew; Nebraska, 1899, *A. J. Bell;* Gordon, Wis., July 12, 1907, *J. J. Davis.*

II. Uredinia hypophyllous, oblong-linear, pulvinate, early naked, chestnut-brown, only slightly pulverulent; urediniospores globose or nearly so, 23–33μ in diameter, wall cinnamon-brown, uniformly thick, 3–6μ, finely and closely verrucose, pores five or more, scattered.

III. Telia hypophyllous, oblong or linear, early naked, pulvinate, firm, chocolate-brown; teliospores broadly ellipsoid or obovate, 22–30 by 30–40μ, somewhat constricted at the septum, rounded at both ends, or narrowed below, wall smooth, medium thick, 3μ, much thickened at apex, 6–10μ, chestnut-brown; pedicel colored, once to twice length of spore.

On *Andropogon Hallii* Hack., Manhattan, Kans., no date, *M. A. Carleton;* Howard Co., Neb., September, 1889, *H. J. Webber;* Kennedy, Neb., Sept. 7, 1908, *J. M. Bates* (Barth., Fungi Columb. *2756*); Red Cloud, Neb., May 7, 1909, *J. M. Bates.*

2. GYMNOSPORANGIUM EXIGUUM Kern, on *Juniperus virginiana* L., collected at Austin, Texas, by Dr. F. D. Heald and Mr. F. A. Wolf, was sown April 26 on *Amelanchier canadensis* with no infection, and at the same time on *Crataegus Pringlei,* giving abundant pycnia May 6, and aecia June 26.

This southernmost species of cedar rust was described a year ago[41] from telial material that was collected in the vicinity of that used for the cultures. The telial description may now be supplemented by a description of the pycnia and aecia. Only one collection of aecia from the field is yet known that can be assigned to this species. It was obtained at Boerne, Texas, not far from San Antonio, and is to some extent on the leaves, but mostly on the fruit of some undetermined species of *Crataegus.* While trees of red cedar of more than one species are abundant in southern Texas where the rust is found, trees of *Crataegus* are rare, and the rust is probably not common.

O. Pycnia fruiticolous and epiphyllous, gregarious, in irregular groups 1–4 mm. across, on discolored hypertrophied areas, prominent, conspicuous, honey-yellow soon becoming blackish, globoid or depressed globoid, 150–165μ in diameter by 100–130μ high; ostiolar filaments 50–65μ long.

I. Aecia fruiticolous and hypophyllous, sparsely arranged in irregular groups, causing considerable hypertrophy of the veins,

[41] Bull. Torrey Club 35: 508. 1908.

petioles, or fruits, cylindrical, 2–3 mm. high; peridium rupturing at the apex, margin not splitting much, erect, peridial cells, usually seen in face view, broadly lanceolate, 29–40 by 70–90μ, inner and side walls thick, 9–14μ, closely spinulose with spine-like papillae up to 6μ long, outer wall thinner, about 3μ, sculptured like the inner and side walls but with shorter papillae; aeciospores globoid or broadly ellipsoid, 22–25 by 26–31μ, wall cinnamon-brown, medium thick, 2–3μ, finely verrucose; pores distinct, 6–8, scattered.

On *Crataegus* sp., Boerne, Texas, June 12, 1908, *G. G. Hedgcock.*

3. GYMNOSPORANGIUM sp. nov. The chain of circumstances which led up to the detection and final culture of this very interesting species of rust is given with sufficient detail in the introduction to this paper, and need not be repeated. Material collected by Mr. F. D. Kern, June 4, 1909, at Leland Mich., on *Juniperus horizontalis* Moench, was sown, June 5, on one plant of *Amelanchier erecta*, and two plants of *A. canadensis.* Numerous pycnia appeared on all three plants, one June 14, and the other two June 16. Owing to the fact that the season was well advanced, and the foliage on the *Amelanchier* plants quite mature, by the time well developed telia could be obtained in the northern habitat, the leaves on all three plants used for cultures ripened and fell before aecia appeared. The field collection of the previous autumn, however, supplied authentic material for study, and the results are not open in the slightest degree to doubt.

It is very gratifying to establish the relationship of the hornlike aecia on *Amelanchier,* as it is now possible to distribute the three very similar forms, that have heretofore gone under one name, and supposed to belong to one cosmopolitan species. The three species are: *Gym. cornutum,* with aecia on *Sorbus,* common to Europe and America, *Gym. Davisii,* with aecia on *Aronia,* known only in America, and the present form with aecia on *Amelanchier,* also known only from America. The first two have their telia on the true juniper, while the last has telia on the red cedar. The new form has been studied morphologically by Mr. F. D. Kern, who has drawn up the following description and supplied the name.

Gymnosporangium corniculans Kern sp. nov.

O. Pycnia epiphyllous, gregarious, in small groups 0. 5–1 mm. across, on discolored spots, rather prominent and conspicuous, honey-yellow, becoming blackish, slightly flattened globose, 130–175μ in diameter by 130–160μ high; ostiolar filaments 50–80μ long.

I. Aecia hypophyllous, crowded in irregular or annular groups, 2–5 mm. across, cylindrical or horn-shaped, acutish at apex, 2–3.5 mm. high; peridium tardily dehiscent by longitudinal slits along the sides, peridial cells usually seen in face view, broadly lanceolate, 16–23 by 64–96μ, inner and side walls rather thick, 5–7μ, moderately verrucose with oval or roundish papillae and a few elongated papillae interspersed, outer wall thin, 1.5–2μ, smooth; aeciospores globoid, 19–26 by 23–32μ, wall dark cinnamon-brown, rather thick, 3–4μ, finely verrucose, appearing nearly smooth.

On *Amelanchier canadensis* (L.) Medic., Burlington, Vt., Sept. 25, 1897, *W. A. Orton;* Fort Spring, W. Va., Sept. 14, 1906, *J. L. Sheldon;* Granville, Mass., Sept. 22, 1890, *A. B. Seymour* (Seym. & Earle, Econ. Fungi *248a*); *Amelanchier erecta* Blanch., Isle Royale, Mich., Aug. 28, 1901, *Stuntz* & *Allen;* Leland, Mich., Sept. 7, 1908, *Arthur* & *Kern; Amelanchier intermedia* Spach, Taughannock Falls, N. Y., Sept. 3, 1908, *Whetzel, Wallace* & *Reddick.*

III. Telia caulicolous, from a perennial mycelium, appearing on irregularly lobed, gall-like excrescences 2–15 mm. or more in diameter, unevenly distributed, often separated by the scars of the sori of previous seasons, conical or cylindrical-acuminate, 1.5–2 mm. in diameter at the base by 3–5 mm. high, dark chestnut-brown; teliospores 2-celled, ellipsoid, 18–21 by 35–50μ, slightly or not constricted at the septum, slight hyaline thickenings over the germ-pores, wall cinnamon-brown, thin 1–1.5μ; pedicel uniform, long; pores 1–2 in each cell, near the septum.

On *Juniperus horizontalis* Moench, Leland, Mich., June 4, 1909, *F. D. Kern.*

4. GYMNOSPORANGIUM sp. nov.—Among the material collected at Santee Canal, S. C. by Mr. F. D. Kern on March 18, 1909, was an abundance of telia on *Juniperus virginiana,* in part extending along the smaller branches often for a foot or more, and referred to above under unsuccessful cultures, and in part forming rather distinct globoid galls from very small up to a half inch or even more in diameter. It was difficult to tell in the field whether there were two species associated or only the incidental

variation of a single species, as both forms bore prominent dark brown telia of quite similar appearance. The cultures, however, settled the question. Sowings were made of the gall-form March 22, on *Crataegus punctata* giving rise to yellow spots after fifteen days, on which pycnia appeared by April 12, but the leaves matured before aecia could form. Other sowings were made May 14 on *Crataegus coccinea* and *C. cerronis,* giving rise to a few belated pycnia on the former, first observed June 14, but on the latter to an abundance of pycnia May 25 and mature aecia October 27.

This fortunate culture adds another species, with life cycle known, to the Atlantic coast rusts of the common red cedar. It does not appear to be represented in herbaria, either in the aecial or telial form, except by some small unnamed fragments. Possibly collections of aecia have been referred to *G. globosum,* which grows on *Crataegus,* although the peridia differ in gross appearance. An interesting point is that this species produces cornute aecia, the first to be noticed on *Crataegus.* The following name and description have been supplied by Mr. Kern, who has also increased the number of aecial hosts by searching in phanerogamic collections.

Gymnosporangium trachysorum Kern, sp. nov.

O. Pycnia epiphyllous, gregarious, in groups 1–2 mm. across, prominent, punctiform, orange-yellow becoming brownish-black, globoid, 144–165μ in diameter by 112–128μ high; ostiolar filaments 75–90μ long.

I. Aecia hypophyllous, rather few in irregular groups 2–5 mm. across, on discolored slightly thickened spots 5–10 mm. or more across, cylindrical, 2–4 mm. high, 0.2–0.3 mm. in diameter; peridium remaining horn-like, finally rupturing by longitudinal slits along the sides, peridial cells long and narrow in side view, 15–19 by 32–90μ, outer wall thin 1.5–2μ, nearly or quite smooth, inner and side walls moderately thick, 3–6μ, closely spinulose with short spine-like papillae interspersed with lower oval or ridge-like papillae; aeciospores globoid or ellipsoid, 15–23 by 18–27μ, wall chestnut-brown, rather thick, about 2.5–3μ, very minutely verrucose, appearing almost smooth; pores about 6, scattered.

On *Crataegus Marshallii* Egg. (*C. apiifolia* Michx.) Auburn, Lee Co., Alabama, Nov. 20, 1897, *F. S. Earle;* Aldenbridge, La.,

Nov. 1, 1898, *Wm. Trelease; Crataegus flavo-carius* Ashe, Salisbury, N. C., Sept. 11 and 12, 1908, *W. W. Eggleston; Crataegus Phaenopyrum* (L. f.) Medic. (*C. cordata* Ait.), Salisbury, N. C., Oct. 7, 1908, Catawba, N. C., Sept. 13 and 14, 1908, *W. W. Eggleston.*

III. Telia cauliculous, from a perennial mycelium, appearing on abruptly fusiform or globoid gall-like enlargements, 0.5–1.5 cm. in diam. by 0.5–3 cm. long, unevenly disposed, sometimes densely crowded, often separated by the scars of the sori of previous seasons, more or less wedge-shaped, 1.5–2 mm. broad by 2–4 mm. long at base by 6–10 mm. high, surface very rough with irregular warts and ridges, dark chestnut-brown; teliospores 2-celled, ellipsoid, 18–21 by 37–45μ, wall cinnamon-brown, medium thin 1.5–2.5μ; pedicel hyaline, very long, uniform; pores 1 or 2 in each cell, near the septum.

On *Juniperus virginiana* L., Santee Canal, S. C., March 18, 1909, *Frank D. Kern* (type); Agricultural College, Miss., April 10, 1893, *S. M. Tracy.*

SUMMARY.

The following is a complete list of the successful cultures made during the year 1909. It is divided into two series, species that have previously been grown in cultures and reported by the writer or other investigators, and species whose culture is now reported for the first time.

A. Species Previously Reported.

1. *Puccinia Peckii* (DeT.) Kellerm.—Teliospores on *Carex lanuginosa* Michx. and on *C. trichocarpa* Muhl., sown on *Onagra biennis* (L.) Scop.

2. *Puccinia Caricis* (Schum.) Schröt.—Teliospores on *Carex aristata* R. Br., sown on *Urtica gracilis* Ait.

3. *Puccinia universalis* Arth.—Teliospores on *Carex stenophylla* Wahl., sown on *Artemisia dracunculoides* Pursh.

4. *Puccinia Caricis-Asteris* Arth.—Teliospores on *Carex festiva* Dewey, sown on *Aster adscendens* Rydb.

5. *Puccinia subnitens* Diet.—Teliospores on *Distichlis spicata* (L.) Greene, sown on *Atriplex hastata* L. and *Chenopodium album* L.

6. *Puccinia amphigena* Diet.—Teliospores on *Calamovilfa longifolia* (Hook.) Hack., sown on *Smilax hispida* Muhl.

7. *Puccinia fraxinata* (Schw.) Arth.—Teliospores on *Spartina cynosuroides* Willd., sown on *Fraxinus lanceolata* Borck.

8. *Puccinia Phragmitis* (Schum.) Körn.—Teliospores on *Phragmites communis* Trin., sown on *Rumex crispus* L.

9. *Puccinia obliterata* Arth.—Teliospores on *Agropyron* sp., sown on *Thalictrum alpinum* L.

10. *Puccinia Muhlenbergiae* Arth. & Holw.—Teliospores on *Muhlenbergia glomerata* Trin., sown on *Callirrhoe involucrata* (T. & G.) A. Gray.

11. *Puccinia Impatientis* (Schw.) Arth.—Teliospores on *Elymus striatus* Willd., sown on *Impatiens aurea* Muhl., and aeciospores on *Impatiens aurea* Muhl., sown on *Elymus virginicus* L., *E. canadensis* L., and *E. striatus* Willd.

12. *Puccinia poculiformis* (Jacq.) Wettst.—Teliospores on *Agropyron pseudorepens* Scribn. & Sm., and *Sitanion longifolium* J. G. Sm., sown on *Berberis vulgaris* L., and aeciospores on *Berberis vulgaris* L., sown on *Triticum vulgare* Vill.

13. *Puccinia substerilis* E. & E.—Amphispores on *Stipa viridula* Trin., sown on same host.

14. *Uromyces Andropogonis* Tracy.—Teliospores on *Andropogon virginicus* L., sown on *Viola cucullata* Ait.

15. *Uromyces Spartinae* Farl.—Teliospores on *Spartina cynosuroides* Willd., sown on *Steironema lanceolatum* (Walt.) A. Gray and *S. ciliatum* (L.) Raf.

16. *Gymnosporangium globosum* Farl.—Teliospores on *Juniperus virginiana* L., sown on *Crataegus coccinea* L.

17. *Gymnosporangium clavipes* C. & P.—Teliospores on *Juniperus sibirica* Burgsd., sown on *Amelanchier erecta* Blanch., and *Crataegus punctata* Jacq.

18. *Gymnosporangium nidus-avis* Thax.—Teliospores on *Juniperus virginiana* L., sown on *Crataegus Pringlei* Sarg., and *Malus Ioensis* (Wood) Britt.

19. *Gymnosporangium Betheli* Kern.—Teliospores on *Juniperus scopulorum* Sarg., sown on *Crataegus cerronis* A. Nels.

20. *Gymnosporangium cornutum* (Pers.) Arth.—Teliospores on *Juniperus sibirica* Burgsd., sown on *Sorbus americana* Marsh., and *S. Aucuparia* L.

21. *Gymnosporangium floriforme* Thax.—Teliospores on *Juniperus virginiana* L., sown on *Crataegus coccinea* L.

22. *Gymnosporangium exterum* Arth. & Kern.—Teliospores on *Juniperus virginiana* L., sown on *Porteranthus stipulatus* (Muhl.) Britt.

23. *Calyptospora columnaris* (A. & S.) Kühn.—Teliospores on *Vaccinium pennsylvanicum* Lam., sown on *Abies Fraseri* Pursh.

B. *Species Reported Now for the First Time.*

1. *Puccinia Ceanothi* (Ellis & Kellerm.) Arth.—Teliospores on *Andropogon Hallii* Hack., sown on *Ceanothus americanus* L.

2. *Gymnosporangium exiguum* Kern.—Teliospores on *Juniperus virginiana* L., sown on *Crataegus Pringlei* Sarg.

3. *Gymnosporangium corniculans* Kern.—Teliospores on *Juniperus horizontalis* Moench, sown on *Amelanchier erecta* Blanch., and *A. canadensis* (L.) Medic.

4. *Gymnosporangium trachysorum* Kern.—Teliospores on *Juniperus virginiana* L., sown on *Crataegus punctata* Jacq., *C. coccinea* L., and *C. cerronis* A. Nels.

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A LEAF BLIGHT OF THE AMERICAN MISTLETOE, PHORADENDRON FLAVESCENS (PURSH) NUTT.

F. A. Wolf

(With Plate 32, Containing 3 Figures)

The American mistletoe, which is known to be largely a water parasite on various species of deciduous trees, is in turn the host of several parasitic fungi. Attention was directed, during the past year, to one of these fungi which causes a diseased condition of the foliage. The material for the study and the field notes on the general symptomology were furnished by Professor Carl Hartmann, of Huntsville, Texas. A detailed study as to the causal organism shows that the trouble is due to an apparently undescribed species of *Macrophoma.*

Recently* a diseased condition of the twigs of the European mistletoe, *Viscum album,* was described as occurring in Germany. This was found to be due to *Macrophoma Visci* Aderh. That this species of *Macrophoma* is not identical with the one occurring on the American mistletoe was clearly shown in the detailed examination which was made.

The disease manifests itself by chlorosis of a part or the whole of the leaf, then the affected foliage becomes darker and is finally dark-brown and dead. At this stage the leaves may fall, so that in severe cases the entire plant may be defoliated, or, as more frequently happens, only part of the leaves are killed. Apparently, the injury to the mistletoe is only temporary, as it renews its activity with the seasonal growth of its host, and new shoots and leaves are formed.

The prominent pycnidia are quite uniformly scattered (*pl. 32, f. 1*) and are present on both leaf surfaces. They are formed within the tissue of the leaf and at maturity rupture the epidermis and protrude by a central ostiole. They are globular or somewhat flattened in shape, dark-brown in color, and vary in

* Aderhold, Rud. Arb. Biol. Abt. Kaiserl. Gesundheitsamt 462–463. 1905.

diameter from 180–210μ. From sections of material fixed in chrom-acetic acid and stained with Haidenheim's iron-alum-haematoxylon, the parenchymatous character of the pycnidium wall was very apparent (*pl. 32, f. 3*).

The spores are oval or elongate, 24–34 × 15–18μ, very densely granular and with several prominent guttulae (*pl. 32, f. 2*). They are not surrounded by a mucilaginous envelope so as to cause them to come out of the pycnidium in ropes or chains, but are extruded singly. Quite frequently, when a pycnidium is crushed or torn open, a portion of the short sporophore remains attached to the spore.

The points of difference between the species on *Viscum album* and this species on *Phoradendron flavescens* are shown in the following tabulation:

	Macrophoma Visci	*Macrophoma Phoradendri*
Ostiolum	absent	present
Pycnidia	300–400μ diam.	180–210μ diam.
Spores	43–66 × 18–21μ	24–34 × 15–18μ
	Elliptic and slightly constricted at the middle, extruded in strands, held together in a mucilaginous matrix	Elliptic and extruded singly

These differences, together with the difference of hosts, would warrant a specific rank; hence the name *Macrophoma Phoradendri* is proposed for this new species, a technical description of which follows:

Macrophoma Phoradendri sp. nov.

Foliis initio flavescentibus demum atro-brunneis; pycnidiis amphigenis, sparsis, globosis, brunneis, primo innatis dein ostiolo perforantibus, 180–210μ, contextu parenchymatico constituto; sporulis oblongis vel ellipsoideis, utrinque rotundatis, plasmate granuloso farctis, continuis, hyalinis, 24–34 × 15–18μ, basidiis brevibus suffultis.

Hab. in foliis vivis *Phoradendri flavescentis* quae desidere faciunt.

Type specimen, No. 3192, Myc. Herb. Dept. Bot., Univ. of Texas, Austin, Texas.

SCHOOL OF BOTANY,
UNIVERSITY OF TEXAS,
AUSTIN, TEXAS.

EXPLANATION OF PLATE XXXII

Fig. 1. Diagrammatic drawing of a mistletoe leaf showing the distribution of the pycnidia.

Fig. 2. Several spores of *Macrophoma Phoradendri*, two of which show the short, broken remnant of the sporophore. × 416.

Fig. 3. A section of the pycnidium showing the protruding ostiole, the character of the pycnidium wall, and the origin of the spores. × 416.

MACROPHOMA PHORADENDRI WOLF

CLADOSPORIUM CITRI MASS. AND C. ELEGANS PENZ. CONFUSED

H. S. Fawcett

A series of errors that need to be corrected appears to have crept into plant disease literature, as to the name of the fungus causing "scab" or "verrucosis" of *Citrus*. The first account of this disease was published by F. Lamson-Scribner in October, 1886.* A fuller account with a colored plate appeared in the annual report of the U. S. Commissioner of Agriculture for 1886 (pp. 120–121). Scribner referred to the fungus as *Cladosporium* sp. A detailed account of the disease and the fungus was later published by W. T. Swingle and H. J. Webber,† who also referred to the fungus as *Cladosporium* sp.

In Tubeuf and Smith's "Diseases of Plants," published in 1897, reference is made on p. 509 to the above authors under the name of *Cladosporium elegans* Penz. This is the beginning of the errors. That the citrus scab referred to by Scribner is not *Cladosporium elegans* is evident from Penzig's description and figures in "Studi Botanici Sugli Agrumi," published in 1887. The dimensions of the spores of *C. elegans* are too large and the pathological effects on the leaf as figured by Penzig are not at all the same as those described by Scribner. The spores of the former are given as $18–20 \times 5–6\mu$, while the latter are $8–9 \times 2.5–4\mu$.

Massee, in his "Text-book of Plant Diseases," published in 1899, described both fungi. On p. 310, he describes the scab under the name of *Cladosporium Citri* "protem," and says: "This *Cladosporium* species is evidently quite distinct from *Cladosporium elegans* Penz. which forms arid, brown spots on living leaves of oranges in Italy." An error in print, however, occurs on p. 436 of the same book, where a technical description of the fungus is given under the heading '*Cladosporium Citri*

* Bull. Torrey Club 13: 181–183. 1886.

† Bull. Div. Veg. Phys. & Path. 8: 20–24. 1896.

Penzig." This error is responsible for the writer's error in the annual report of the Florida Experiment Station for 1907, p. xxiii, where the fungus is mentioned as *Cladosporium Citri* Penz., instead of *Cladosporium Citri* Mass. Presumably as a result of Tubeuf and Smith's mistake, this fungus has been erroneously referred to as *Cladosporium elegans* Penz. in the following publications:

"Citrus Fruits and Their Culture," by H. H. Hume, published in 1904.

"First Annual Report of the Cuban Experiment Station, for 1904, 1905," by F. S. Earle.

"Bulletin 9 of the Cuban Experiment Station," by M. T. Cook and W. T. Horne, 1909.

Specimens of this fungus have been issued recently in "Fungi Columbiani" by E. Bartholomew under the name of *Cladosporium Citri* Mass., which is undoubtedly the name by which it should be designated.

AGRIC. EXP. STATION,
GAINESVILLE, FLA.

A NEW HOST AND STATION FOR EXOASCUS FILICINUS (ROSTR.) SACC.

W. C. Coker

On May 14 of this year, I noticed a number of plants of the Christmas fern (*Dryopteris acrostichoides*) whose fronds were attacked by a fungus, causing well-defined yellowish areas up to a centimeter or more wide on both the sterile and fertile leaflets. The ferns were growing in a deep ravine along the Raleigh Road, Rocky Ridge Farm, Chapel Hill, N. C. Specimens were brought to the N. Y. Botanical Garden, where Mr. F. J. Seaver determined the fungus as *Exoascus filicinus* (Rostr.) Sacc. (*Taphrina filicina* Rostr.), and careful dissections and measurements made by me showed our parasite to agree in every way with descriptions of that species. The asci do not break through nor push off the epidermis, but form a dense layer on its surface. They are small, averaging about 33 μ long and 5 or 6 μ wide, and the spores are about 5 μ long and 2 μ thick.

This *Exoascus* seems to have been observed heretofore only in Sweden, on *Dryopteris spinulosa* (*Polystichum spinulosum*). It will probably be found in other places in America and on still other species of *Dryopteris*.

Chapel Hill, N. C.

A NEW BOLETUS FROM MEXICO

W. A. Murrill

During a recent exploring expedition in southern Mexico, diligent search was made for species of Boletaceae, but only one plant was found, which proved to be undescribed.

Only seven species of this family were previously known from tropical America.*

Ceriomyces jalapensis sp. nov.

Pileus small, convex, circular in outline, 2.2 cm. in diameter, 1 cm. thick; surface isabelline to fulvous, slimy, smooth: context white to faintly roseus, mild to the taste, 2 mm. thick behind; hymenium convex, depressed in the form of a crater about the stipe, tubes pale-greenish, 7 mm. long, mouths large, rounded, 1–2 to a mm., edges thin: spores ellipsoid, deep-ferruginous, distinctly longitudinally striate, copious, $13–15 \times 7–9 \mu$: stipe central, slender, tapering upward, concolorous, smooth, glabrous, not conspicuously slimy like the cap, swollen and white at the base, 6 cm. long, 4 mm. thick at the middle.

Type collected near Jalapa, Mexico, at an elevation of 1,700 meters, in humus in a virgin forest, December 12–20, 1909, *W. A. & Edna L. Murrill 354*.

* Mycologia 1: 219. 1909.

NEWS AND NOTES

Mr. Fred J. Seaver, director of the laboratories, left August 15 for Colorado, where he will spend several weeks collecting fungi.

Professor D. R. Sumstine, curator of the fungus collection of the Carnegie Museum at Pittsburg, held a research scholarship at the Garden during the month of July.

Dr. N. L. Britton, director-in-chief, accompanied by Mrs. Britton and Dr. C. Stuart Gager, recently appointed director of the Brooklyn Botanic Garden, sailed for Cuba August 20 to continue botanical exploration in the western part of that island.

Miss Mary F. Barrett, of the State Normal School at Montclair, New Jersey, spent the month of July at the Garden studying the collections of gelatinous fungi, in preparation of a monograph of this group for North American Flora.

A treatment by F. L. Stevens of the chief fungous diseases of the apple and pear from a practical standpoint appears in bulletin 206 of the North Carolina Agricultural Experiment Station, dated March, 1910.

Professor William J. Beal, having completed forty years of continuous service, will resign his professorship in botany at the Agricultural College of Michigan.

Professor John M. Macfarlane, of the University of Pennsylvania, is planning to spend the coming year in study in several botanical centers of Europe.

An extensive illustrated paper on "Les Champignons dits Ambrosia," by J. Beauverie, has very recently appeared (Ann. Sci. Nat. Bot. IX. **11**: 31–73. *pl. 1–5.* 1910). The fungi considered,

belonging to *Macrophoma, Ceratostomella* and *Dematium*, are in symbiotic relation with certain insects that provide them favorable conditions for development in return for substantial nourishment.

The Naples Table Association for Promoting Laboratory Research by Women hereby announces the offer of a fifth prize of one thousand dollars for the best thesis written by a woman, on a scientific subject, embodying new observations and new conclusions based on an independent laboratory research in biological, chemical, or physical science. For further information address the secretary, Mrs. A. D. Mead, 283 Wayland Avenue, Providence, R. I.

Mr. C. W. Edgerton has recently made a careful study of the bean anthracnose in Louisiana (La. Agric. Exper. Sta. Bull. **119**: 1–55. *pl. 1–14.* 1910). He finds that the fungus will not tolerate a continued high temperature and is consequently killed out during the summer months in that latitude. Other micro-organisms in the soil, also, especially a species of *Fusarium*, easily gain entrance to the diseased seed and either rot the seed entirely or run out the anthracnose in the spots. These two natural factors, heat and micro-organisms, are very important in the control of the disease and may be used to greatly lessen its ravages in Louisiana.

The Bulletin from the Laboratories of Natural History of the State University of Iowa (**6**: 41–219) contains a treatment of the Iowa Discomycetes by Mr. Fred J. Seaver. This paper stands in part as a revision and in part as an extension of the work entitled "The Discomycetes of Eastern Iowa" published by the same author in volume five of said bulletin. The work consists of ninety-one pages of text with a record of one hundred and twenty species, and forty-one plates illustrating ninety-four species. The paper contains no new species and few new combinations, but five species are recorded which have been described and based on Iowa material since the publication of the "Discomycetes of Eastern Iowa." The paper is offered as a contribution from the New York Botanical Garden, no. 133.

Dr. W. A. Murrill, assistant director, recently returned from Virginia with a collection of poisonous fungi, which will be chiefly used for chemical analysis. Returning, he found evidences of the chestnut canker not far from Baltimore, Maryland, and diseased trees became more abundant northward. At Belair, Maryland, seventy-five miles south of Philadelphia, and at Northeast, Maryland, the effects of the canker were very noticeable, most of the chestnut trees being dead or in a dying condition. At Red Bank, New Jersey, where the first chestnut trees were observed near the coast, the disease had become very serious and was noticed from this point all the way to New York City, especially near South Amboy, New Jersey, where whole forests were either killed or badly affected. Throughout the whole of Staten Island not a single healthy chestnut tree was observed; and the same was true of Long Island so far as his observations went.

"Pod-Rot, Canker, and Chupon-Wilt of Cacao caused by Phytophthora sp." is the title of an interesting illustrated article by J. B. Rorer (Bull. Dept. Agric. Trinidad **9**: July, 1910). The three diseases mentioned are met with on almost every cacao estate in Trinidad, and probably occur in most of the countries where cacao is grown commercially. Trees exposed to infection should be sprayed four times a year, avoiding the periods of full bloom; and cancerous spots should be cut out and the wounds treated to prevent re-infection from diseased pods.

The Report of the Botanist of New York State for the year 1909, containing 114 pages and 10 colored plates, includes descriptions of several new species; monographs of the New York species of *Inocybe* and *Hebeloma;* a list of edible, poisonous, and unwholesome mushrooms hitherto figured and described by C. H. Peck; and a list of genera whose New York species have been collated with descriptions in the reports of the state botanist.

The new species of fungi here described by Dr. Peck are: *Belonidium Glyceriae, Diplodia Hamamelidis, Dothiorella divergens, Hypholoma Boughtoni, Hypholoma rigidipes, Marasmius*

alienus, Phomopsis Stewartii, Psilocybe nigrella, Septoria sedicola, Trametes merisma, and *Trichosporium variabile*.

A recent bulletin on the subject of "Fire Blight of Pears, Apples, Quinces, etc." (Cornell Univ. Agric. Exper. Sta. Bull. **272**: 31–51. 1910), by H. H. Whetzel and V. B. Stewart, gives directions for controlling this disease in the orchard. The method may appear complicated and tedious, but those who are acquainted with fire blight will welcome any method, no matter how exacting, that will control it.

In this connection, it is interesting to note the results of tests made with one of the so-called blight remedies, claimed to render trees immune by the introduction of various substances into the sap. Callahan's Blight Specific was thoroughly tested and proved to be not only worthless as a preventive, but positively injurious, causing heart-rot. The grayish-green powder that was inserted into the trunk according to directions, consisted of sulfur, with a little charcoal to color it and some asafetida to give it an effective odor. The use of such specifics has frequently been recommended for chestnut canker.

"Some Sugar Cane Diseases" (La. Agric. Exper. Sta. Bull. **120**: 1–28. 1910), by C. W. Edgerton, may be summarized as follows:

During the past season the sugar planters of Louisiana have had considerable trouble in obtaining good stands of cane. The investigations of the Experiment Station have shown the trouble to be due primarily to several fungous diseases. These diseases have been much more severe this year than in previous years on account of the very dry spring. The dry weather reduced the vitality of the cane and made it more susceptible to the diseases.

The diseases present in the state are the red rot, caused by *Colletotrichum falcatum*, the rind disease, due to *Melanconium Sacchari*, the pineapple disease, due to *Thielaviopsis ethaceticus*, and the root rot, caused by *Marasmius plicatus*, one of the gill-fungi. The red rot, rind disease, and root rot are widely distributed over the state, but the pineapple disease is at present only known in one parish.

Each of these diseases is described and the methods of treatment discussed in the above bulletin.

Professor A. D. T. Cockerell, of the University of Colorado, makes some interesting suggestions in a recent number of *Science* (32: 205. 1910) regarding the preservation of type specimens. The appointment of a committee by the American Association is recommended, this committee to investigate and report upon the condition of types in various institutions in this country and to designate certain museums as fit places for their preservation.

The principles enunciated by Professor Cockerell are as follows:

"1. A type is, from its nature, in some sense the property of the scientific world. Thus, every one would consider it a criminal act to purchase and then willingly destroy a type. It must be considered reprehensible to permit types to exist where they are in serious danger of being destroyed, and, in particular, steps should be taken to prevent the sale of types to miscellaneous unknown collectors after the death of the original owner.

"2. Every institution possessing types should publish a complete list of those in its custody, and subsequently annual lists of additions. It can then be held strictly accountable for their care, and students can ascertain where the types are to be seen.

"3. No types should ever be loaned out and, especially, they should never be sent through the mails. Experience shows that institutions which profess to have a rule against the loaning of types can not be trusted to keep it."

EDIBLE MUSHROOMS IN FRANCE

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POISONOUS MUSHROOMS

William A. Murrill

Considerable attention has been given in these pages to edible species of mushrooms, but very little has been said about poisonous species. This is partly due to the small percentage of the latter as compared with the edible and harmless kinds, and partly to the very inadequate knowledge we have of the poisons contained in mushrooms.

The purpose of the present article is to give a general introduction to the subject and to outline the problems to be solved, with the hope that observations and experiments will be made which will contribute to a more accurate and more practical knowledge of the poisonous species native to this country. In the near future, it is our intention to reproduce in this journal several of these species in their natural colors, and to accompany them with descriptions and notes regarding their chemical composition and their physiological effects on the animal system.

Considering its importance, it is remarkable how little is really known about this subject; and the statements and opinions of various authors are so conflicting that one often does not know what to believe regarding the commonest and best known forms. Most of the literature centers about two species, *Amanita muscaria* and *Amanita phalloides,* which, owing to their abundance, wide distribution, conspicuous appearance, and deadly qualities, have been the chief causes of death from mushroom eating the world over. The clinical side of the subject is an old one, but

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careful chemical investigation into the causes of the effects observed dates back only about two decades, being dependent upon the development of modern methods in organic chemistry.

As the use of mushrooms in this country for food becomes more general, the practical importance of this subject will be vastly increased, and it may be possible to discover perfect antidotes or methods of treatment which will largely overcome the effects of deadly species. This would be a great boon even at the present time, and there will always be children and ignorant persons to rescue from the results of their mistakes. Another very interesting field, both theoretical and practical in its scope, is the use of these poisons in minute quantities as medicines, as has been done with so many of the substances extracted from poisonous species of flowering plants, and even from rattlesnakes and other animals. Thus far, only one of them, the alkaloid muscarine, has been so used.

The poisons found in flowering plants belong chiefly to two classes of substances, known as alkaloids and glucosides. The former are rather stable and well known bases, such as aconitine from aconite, atropine from belladonna, nicotine from tobacco, and morphine from the poppy plant. Glucosides, on the other hand, are sugar derivatives of complex, unstable, and often unknown composition, such as the active poisons in digitalis, hellebore, wistaria, and several other plants.

The more important poisons of mushrooms also belong to two similar classes, one represented by the alkaloid muscarine, so evident in *Amanita muscaria*, and the other by the deadly principle in *Amanita phalloides*, which is known mainly through its effects. Besides these, there are various minor poisons, usually manifesting themselves to the taste or smell, that cause local irritation and more or less derangement of the system, depending upon the health and peculiarities of the individual.

The history of mushroom poisoning reaches back to Babylonia and ancient Rome, and every year since then has added to the list of victims, many of whom have been persons of importance. In some cases, poisonous species were used in committing murder. The annual number of deaths in the United States due to mistaking poisonous species for edible ones is probably fifty or more, many of which are not reported.

The characters and tests used to distinguish poisonous mushrooms have been most varied and curious, and nearly always mixed with queer traditions and superstitions. If the percentage of deadly forms were not so small, probably not over one per cent., the fatalities from this source would have undoubtedly been much more numerous. The only safe rule to follow is the one used with other plants, namely, to know each species accurately before eating it. Even the rules carefully formulated by mycologists are almost certain to prove unreliable as men grow bolder and attempt to eat species not previously tested, because everything that is known in this field has been discovered by experiment, and predictions or generalizations of any kind are both unscientific and unsafe. It may be possible to forecast accurately the discovery of a new chemical element with given properties, but mushrooms have not yet been reduced to that basis. The sweeping statement that brown-spored and black-spored species are always safe was only recently controverted by the accidental discovery of the poisonous properties of *Inocybe infida.* The genus *Amanita,* while including the principal deadly species, contains also many that are widely used as food, the differences often being so slight as to be overlooked by experienced collectors.

The genus *Amanita* is distinguished from other white-spored genera by the presence of a universal veil which encloses the entire sporophore in its young stage and remains either at the base of the stipe or as warts on the surface of the pileus when the sporophore is mature. Over thirty American species are listed, but hardly half of them are worthy of the rank, and only five of these are known to be poisonous. The other species mentioned in the following discussion belong to various and widely different genera.

Discomycetes

Most of the cup-fungi that are large enough to be called "mushrooms" are edible, only one conspicuous species, *Gyromitra esculenta,* having a questionable reputation, and this only in old or decaying specimens, which have been found to contain helvellic acid, a deadly poison similar to that occurring in *Amanita phalloides.* Although young and fresh specimens of *Gyromitra esculenta* have been frequently eaten without harm, it is wise to refrain from using the plant for food in any form.

Hymenomycetes

This group comprises tremelline forms, such as *Tremella* and *Auricularia;* fleshy, coral-like forms, such as *Clavaria* and *Sparassis;* thin, tough forms with smooth hymenium, such as *Thelephora* and *Stereum;* fleshy or woody forms with spiny hymenium, such as *Hydnum* and *Odontia;* tough or wood-loving forms with porous hymenium, such as *Polyporus* and *Fomes;* fleshy, terrestrial forms with porous hymenium, such as *Boletus* and *Ceriomyces;* and tough or fleshy forms with true gills, such as *Agaricus* and *Amanita.* In all of these divisions except the last two, the species are usually considered either harmless or too tough for food. One woody species of polypore, *Fomes Laricis,* contains a poison and is used in medicine. The poisonous or suspicious species of the Boletaceae and the Agaricaceae will now be taken up in alphabetical order and their poisonous properties discussed.

It must be clearly understood, however, that this list does not contain all the poisonous mushrooms in America. The only safe method of procedure for the mycophagist is to have two lists, one of species to avoid, and another of species that have been thoroughly tested and found safe under all conditions. The accompanying illustrations are made from colored charts published some years ago in France, intended to give popular instruction in distinguishing poisonous and edible mushrooms. Excellent charts of this kind have also been known for many years in Sweden, owing to the work of Elias Fries at Upsala. Regarding these charts, it must be remembered, first, that they soon get out of date, and, second, that the person using them should have a good general knowledge of the characters of mushrooms, otherwise there will be mistakes, which may sometimes prove fatal, especially in distinguishing the species of *Amanita.* In the case of this genus, I would strongly advise everyone to let all of its species severely alone, so far as eating them goes, and thus eliminate many chances of error.

BOLETACEAE

CERIOMYCES FERRUGINATUS (Batsch) Murrill

Considered slightly poisonous by most mycologists, but MacIlvaine claims that it loses its peppery taste on cooking and becomes perfectly harmless.

CERIOMYCES MINIATO-OLIVACEUS (Frost) Murrill

Poisonous to some and harmless to others. A case of poisoning by this species was reported by Collins in Rhodora for 1899.

SUILLELLUS EASTWOODIAE Murrill.

Properties unknown, but belonging to a suspicious genus.

SUILLELLUS FROSTII (Russell) Murrill

Usually viewed with suspicion because of its red hymenium, but its properties are not accurately known.

SUILLELLUS LURIDUS (Schaeff.) Murrill

Avoided by most persons and said to contain a small amount of muscarine or closely allied alkaloid, as well as choline, but eaten by others for many years without harmful effects, both in this country and in Europe. Owing to the variety of its forms, it is liable to be confusing unless one uses the red tube-mouths as a distinguishing character and avoids the whole genus, which is the wisest thing to do until its species are more thoroughly tested.

SUILLELLUS MORRISII (Peck) Murrill

Properties unknown. Taste mild, but the species, which is very rare, needs to be tested.

SUILLELLUS RUBINELLUS (Peck) Murrill

Properties unknown. Taste mild, but the species needs to be tested.

TYLOPILUS FELLEUS (Bull.) P. Karst.

Usually intensely bitter, both raw and cooked, and therefore inedible, but not generally considered poisonous.

AGARICACEAE

AMANITA COTHURNATA Atkinson

This species was collected in quantity in Virginia during the past summer for investigation. While drying the fresh sporophores in the sun, hundreds of flies were attracted to their viscid surfaces and were paralyzed in great numbers after sucking the juice, thus indicating a close relationship with *A. muscaria.*

AMANITA MUSCARIA L.

One of the most deadly mushrooms, celebrated for centuries on account of its poisonous properties, due to the alkaloid muscarine, which affects the ganglia controlling the nerves of the heart and thus retards and finally stops its action, if taken in sufficient quantity. Atropine has the opposite effect on the heart, and has therefore been successfully used as an antidote for muscarine. It is said that daturine, the alkaloid from *Datura Stramonium*, is sometimes used for this purpose instead of atropine.

FIG. 1. French chart showing deadly poisonous species.

The literature of this species is more extensive than that of all other poisonous species combined. It lacks the death-cup and must be carefully distinguished taxonomically; it has been generally used as a fly-poison, and also as an exhilarant in certain parts of Russia; it is celebrated in history because of its long and distinguished list of victims; it has been chemically analyzed more often and more successfully than any other species; and an antidote for its principal poison has been discovered. The writings of Palmer, Mendel, MacIlvaine, Carter, Gibson, Atkinson, Clark, Coville, Chestnut, Peck, Herbst, Kobert, Zellner, Esser, Ford, and others contain many interesting details regarding this species.

AMANITA PANTHERINA DC.

Considered poisonous by all authors, causing intoxication similar to that caused by *A. muscaria,* though in milder form, and containing both muscarine and choline. It is said to be the chief poisonous mushroom of Japan, but has rarely been known to be fatal.

AMANITA PHALLOIDES Fries

This most deadly species, for which no antidote is known, occurs in many forms and colors, but is always characterized by the presence of a prominent death-cup at the base of the stipe. The principal poison is not accurately known chemically, neither have its exact effects on the animal system been determined, although it has been much investigated both by physiologists and chemists. For the rather extensive literature of the subject, the reader is referred to the authors cited under *Amanita muscaria.* It is reasonable to expect that at no very distant date an antidote will be discovered for the deadly amanita, as has been the case with rattlesnake poison and the toxin accompanying diphtheria.

AMANITA STROBILIFORMIS Villad.

This species, according to Ford, contains a small quantity of the deadly poison found in *A. phalloides* and should never be eaten, although claimed by some authors to be harmless. Owing to the present confusion regarding the limitation of species closely related to *A. strobiliformis,* it is wise to suspect the whole group until better known.

CHANTEREL ALECTOROLOPHOIDES (Schaeff.) Murrill

This species, usually known as *Cantharellus aurantiacus* Fries, has been recently investigated, along with *C. tubaeformis,* by Sartory, who pronounces both of them harmless.

CLITOCYBE ILLUDENS Schw.

Pronounced poisonous, though not fatal, by all mycologists who have tested it. Dr. Farlow reported a severe case of poisoning from it in *Rhodora* in 1899. It causes nausea and is soon rejected by all but the strongest stomachs.

ENTOLOMA GRANDE Peck

This species is suspected, possibly on account of the two poisonous European species, *E. lividum* and *E. sinuatum*. It is well to avoid all of our species until thoroughly tested.

HEBELOMA FASTIBILE Fries

Considered poisonous by some, possibly owing to its pungent taste and odor. One or two species of the genus have a bad reputation in Europe. *Hebeloma* is very closely related to the genus *Inocybe*.

INOCYBE INFIDA Peck

An account of the poisonous effects of this species was published in MYCOLOGIA for September, 1909. It has since been col-

FIG. 2. French chart showing species considered dangerous.

lected in large quantities and is now being investigated by Dr. W. J. Gies and his assistants.

LACTARIA

Many species of this genus were formerly considered poisonous on account of their acrid taste, but, since it has been found that these peppery, resinous substances are usually decomposed on cooking, it will be necessary to make an experimental revision of the genus. *Lactaria rufa* seems to enjoy the worst reputation,

from all accounts, while *L. torminosa, L. fuliginosa, L. vellerea, L. pyrogala,* and *L. theiogala* are either pronounced poisonous or suspicious by most authors. Care should be exercised in collecting members of this genus for the table.

LEPIOTA MORGANI Peck

This species, which occurs rather abundantly from Indiana to Kansas and south to Texas, may be readily distinguished from *Lepiota americana* and other species of the genus by its green spores. It is harmless to some persons but poisonous to others, though never fatal. Old specimens appear to contain more poison than young ones.

MARASMIUS PERONATUS Fries

Considered slightly poisonous to some persons. It occurs in woods and is sufficiently distinct from *M. oreades* to avoid confusing the two. It is probably only a form of *M. urens*.

MARASMIUS URENS Fries

This species, long considered slightly poisonous, grows in pastures and should be carefully distinguished from *M. oreades*.

PANAEOLUS CAMPANULATUS Fries

A century ago this species was reported poisonous, inducing sleep. MacIlvaine has tried it in small quantities without harmful results.

PANAEOLUS PAPILIONACEUS Fries

Said to produce hilarity and a mild form of intoxication if eaten in quantity.

PANUS STYPTICUS Fries

Extremely astringent and disagreeable, and considered poisonous by all authors. Some say that it is a violent purgative. On account of its small size and apparently tough consistency, few persons would think of eating it.

RUSSULA

It seems to be pretty well established for the American species of this genus that have been investigated that all having an agree-

able taste and odor are harmless; but the distinctions between species are so slight that it is usually necessary to test each individual specimen before cooking it. *Russula emetica* is poisonous, containing choline, pilzatropine, and probably muscarine; *R. foetens* is also poisonous, but in a lesser degree; while *R. nitida, R. fragilis,* and other species belong to the mildly poisonous or suspected class. No experiments will be of great value until the genus is better known botanically.

TRICHOLOMA SULFUREUM Fries

This species has a strong and disagreeable odor and is considered poisonous by some authors.

VOLVARIA

One species is classed among the very poisonous mushrooms by some European authors, and rosy-spored species in general have long been suspected and avoided by many persons.

Gasteromycetes

Remarkably little is definitely known regarding the properties of the phalloids, the only suspected group of the gasteromycetes. It seems that the strong and very disagreeable odor of many of these plants has discouraged experimentation in this line, and certainly no one would use them for food unless by mistake. *Phallus impudicus, Dictyophora duplicata, Clathrus cancellatus,* and other species have been usually considered poisonous. MacIlvaine has tested the eggs of a few species and found them harmless, while mature specimens are said to be uniformly fatal to swine. Esser suggests that the sporogenous tissue develops the poison, but this would be strange in view of the fact that the very purpose of this tissue with its peculiar odor is to attract flies, which devour it without harmful results. This group, like so many others, only emphasizes the need of much careful investigation before our knowledge of poisonous mushrooms will be anything like complete.

THE SMUTS AND RUSTS OF UTAH

A. O. Garrett

This catalogue of smuts and rusts represents the results of eight years of the writer's field work, mostly in Salt Lake, Davis, Summit, Wasatch, Utah, Weber and Sevier counties. The catalogue does not include a complete list of all species known to have been collected in Utah; but only those that have been collected by the writer.

As will be seen from the localities given, most of the collections have been made in Salt Lake County. Unless otherwise specified, all of the canyons mentioned are those of the Wasatch mountains in Salt Lake county. These mountains are a few miles east of Salt Lake City, and run north and south. A spur running east and west forms the northern boundary of the city. City Creek Canyon, in this spur, is nearly due north of the city; to the eastward comes Dry Canyon, and nearly due northeast of the city, Red Butte or Reservoir Canyon. Directly east is Emigration Canyon, the pass through which the pioneers came in the early days. To the south of Emigration is Parley's Canyon, and a mile to the south is Mill Creek, then Big Cottonwood, and finally, three miles south on the boundary of the county, fifteen miles southeast of Salt Lake City, is the mouth of Little Cottonwood. For the most part, these canyons have a length of about fifteen miles; and their altitude increases from about 5,000 feet at the mouth to 8,000–11,000 feet at their head. In general, the altitudes of Salt Lake County vary from 4,210 feet, the level of Great Salt Lake, to 11,563 feet, at the summit of Twin Peaks.

Great care has been taken both in the determination of the host and of its parasite, all specimens having been submitted to specialists for their opinion. In this connection, the writer gratefully acknowledges the assistance rendered by Dr. J. C. Arthur, Dr. P. Sydow, Professor E. W. D. Holway, and Dr. G. P. Clinton for the determination or verification of specimens of rusts and of smuts; and to Dr. P. A. Rydberg, Professor A. S. Hitchcock,

Dr. Aven Nelson, Professor Marcus E. Jones and Miss Alice Eastwood for the determination or verification of the host-plants. To Professor Holway the writer's thanks are also due for furnishing many of the citations given; and to Dr. Arthur for his criticism of the manuscript of the rusts.

USTILAGINALES

USTILAGINACEAE

1. CINTRACTIA CARICIS (Pers.) Magn.

Uredo Caricis Pers. Syn. Fungi 225. 1801.

In ovaries of *Carex* sp.: *416*, July 7, 1904, City Creek Canyon.

2. SCHIZONELLA MELANOGRAMMA (DC.) Schröt.

Beitrag. Biol. Pfl. **2**: 362. 1877.

In leaves of *Carex* sp.: *289*, Aug. 15, 1903, near Lake Mary, Big Cottonwood Canyon, 9,500 feet. In leaves of *Carex nebraskensis* Dewey (*C. Jamesii* Torr.): *639*, May 6, 1905, near Liberty Park, Salt Lake City. In leaves of *Carex* sp.: *1002*, June 25, 1907, Red Butte Canyon.

3. SOROSPORIUM SAPONARIAE Rud.

Linnaea **4**: 116.

In inflorescence of *Silene Menziesii* Hook.: *956*, Aug. 27, 1906, Mt. Majestic, Big Cottonwood Canyon. Determined by Dr. Clinton. This is the first collection of the species in this country.

4. THECAPHORA DEFORMANS Dur. & Mont.

Ann. Sci. Nat. III. **7**: 110. 1847.

In ovaries of *Lathyrus utahensis* Jones: *981a*, Sept. 13, 1906, Parley's Canyon. In ovaries of *Vicia oregana* Nutt.: *1021*, July 20, 1907, City Creek Canyon.

5. THECAPHORA TRAILII Cooke,

Grevillea **11**: 155. 1883.

In heads of *Carduus leiocephalus* (D. C. Eaton) Heller: *834*, Aug. 14, 1905, Big Cottonwood Canyon.

6. USTILAGO BROMIVORA (Tul.) Fisch. de Waldh.

Bull. Soc. Nat. Mosc. **40**[1]: 252. 1867.

In ovaries of *Bromus hordeaceus* L.: *210*, June 10, 1903, Salt Lake City. In ovaries of *Bromus polyanthus* Scribn.: *836a*, Aug. 15, 1905, Big Cottonwood Canyon. In ovaries of *Bromus marginatus* Nees: *1161*, Aug. 28, 1908, Red Butte Canyon.

7. USTILAGO CRUS-GALLI Tracy & Earle,

Bull. Torrey Club **22**: 175. 1895.

In stems and leaves of *Panicum Crus-galli* L.: *616*, Sept. 16, 1904, Salt Lake City.

8. USTILAGO GAYOPHYTI Hark.

Bull. Calif. Acad. **1**: 36. 1884.

In ovaries of *Gayophytum caesium* Nutt.: *857*, Aug. 22, 1906, Big Cottonwood Canyon, 8,650 ft. In ovaries of *Gayophytum intermedium* Rydb.: *501*, Aug. 27, 1904, Big Cottonwood Canyon.

9. USTILAGO HYPODYTES (Schlecht.) Fries,

Syst. Myc. **3**: 518. 1832.

In leaves and inflorescence of *Sitanion californicum* Smith: *2009*, June 19, 1909, Salt Lake City. This is the unusual form referred to by Griffiths in Bull. Torrey Club **31**: 87. In inflorescence of *Eriocoma cuspidata* Nutt.: *2059*, July 31, 1909, Fish Creek Canyon, western Sevier Co.

10. USTILAGO LEVIS (Kellerm. & Sw.) Magn.

Abh. Bot. Ver. Prov. Brand. **37**: 69. 1896.

In ovaries of *Avena sativa* L.: *243*, July 15, 1903, Salt Lake City; *2052*, July 29, 1909, Clear Creek Canyon, western Sevier Co.

11. USTILAGO LONGISSIMA (Sow.) Tul.

Sow. Eng. Fungi, pl. 139. 1799.

In leaves of *Glyceria nervata* Trin.: *615*, Sept. 15, 1904, Salt Lake City.

12. USTILAGO LORENTZIANA Thüm.

Flora **63**: 30. 1880.

In ovaries of *Hordeum jubatum* L.: *392*, June 20, 1904, Poplar Grove, Salt Lake City. In ovaries of *Hordeum nodosum* L.: *165*, Oct. 12, 1902, Liberty Park, Salt Lake City. In ovaries of *Hordeum pusillum* Nutt.: *485*, Aug. 18, 1904, Liberty Park, Salt Lake City. In nodes of inflorescence of *Sitanion californicum* Smith: *2008*, June 19, 1909, Salt Lake City.

13. USTILAGO MACROSPORA Desmaz.

Pl. Crypt. **11**: 1727. 1850.

In leaves of *Elymus robustus* Scribn. & Smith: *257*, Aug. 3, 1903, Salt Lake City, 4,400 feet.

14. USTILAGO STRIAEFORMIS (Westend.) Niessl.

Hedwigia **15**: 1. 1876.

In leaves of *Elymus robustus* Scribn. & Smith: *890*, June 23, 1906, Parley's Canyon. In leaves of *Elymus glaucus* Buckl.: *959*, July 17, 1906, Parley's Canyon.

15. USTILAGO MULFORDIANA Ellis & Ev.

Bull. Torrey Club **22**: 362. 1895.

In inflorescence of *Festuca octoflora* Walt.: *666*, June 14, 1905, Salt Lake City.

16. USTILAGO ZEAE (Beckm.) Ung.

Einfl. Bodens 211. 1836.

In inflorescence of *Zea mays* L.: *531*, Sept. 10, 1904, Salt Lake City.

TILLETIACEAE

17. ENTYLOMA CRASTOPHILUM Sacc.

Michelia **1**: 540. 1879.

In leaves of *Catabrosa aquatica* (L.) Beauv.: *611a*, Sept. 1, 1904, Red Butte Canyon. P. Sydow calls this *E. Catabrosae* Johans.

18. ENTYLOMA COMPOSITARUM Farl.

Bot. Gaz. **8**: 275. 1883.

In leaves of *Erigeron Coulteri* Porter: *953*, Aug. 27, 1906, Big Cottonwood Canyon, 8,750 feet.

19. TILLETIA ASPERIFOLIA Ellis & Ev.

Jour. Myc. **3**: 55. 1887.

In ovaries of *Sporobolus asperifolius* (Nees. & Mayen) Thurb.: *486a*, Aug. 18, 1904, Liberty Park, Salt Lake City.

20. TILLETIA TRITICI (Bjerk.) Wint.

Rabenh. Krypt. Fl. **1**[1]: 110. 1881.

In ovaries of *Triticum vulgare: 633a*, Salt Lake City.

21. UROCYSTIS AGROPYRI (Preuss.) Schröt.

Abh. Schles. Ges. Abth. Nat. Med. **1869–72**: 7. 1870.

In leaves of *Agropyron tenerum* Vasey: *934*, Aug. 17, 1906, near Lake Mary, Big Cottonwood Canyon.

22. UROCYSTIS ANEMONES (Pers.) Wint.

Rabenh. Krypt. Fl. **1**[1]: 123. 1881.

In leaves and stems of *Ranunculus Eschscholtzii* Schlecht: *305*, Aug. 13, 1903, Lake Martha, Big Cottonwood Canyon, 9,605 feet. In stems and leaves of *Ranunculus digitatus* Hook.: *710*, July 3, 1905, head of south fork, Big Cottonwood Canyon. In leaves and stems of *Ranunculus stenolobus* Rydb.: *500*, Aug. 27, 1904, Big Cottonwood Canyon, 9,410 feet.

23. UROCYSTIS CARCINODES (Berk. & Curt.) Fisch. de Waldh.

Aperçu Syst. Ust. 38. 1877.

In stems and leaves of *Actaea arguta* Nutt.: *276*, Aug. 13, 1903, Big Cottonwood Canyon, 9,000 feet. In stems and leaves of *Atragene occidentalis* Hornem.: *820*, Aug. 10, 1905, Big Cottonwood Canyon, 9,000 feet.

24. UROCYSTIS LITHOPHRAGMAE Garrett,

N. Am. Fl. **7**: 56. 1906.

In leaves of *Lithophragma bulbifera* Rydb.: *741*, July 10, 1905, head of Little Cottonwood Canyon. Known only from the type locality.

25. UROCYSTIS SOROSPOROIDES Körn.

Fisch. de Waldh. Aperçu Syst. Ustilag. 41. 1877.

In stems and leaves of *Aquilegia caerulea* James: *284*, Aug. 15, 1903, Big Cottonwood Canyon, 9,000 feet. In stems and leaves of *Aquilegia flavescens* Wats.: *284a*, Aug. 15, 1903, Big Cottonwood Canyon. In stems and leaves of *Aquilegia leptocera* Nutt.: *496*, Aug. 22, 1904, Big Cottonwood Canyon. In stems and leaves of *Thalictrum sparsiflorum* Turcz.: *793*, July 29, 1905, Big Cottonwood Canyon.

26. UROCYSTIS VIOLAE (Sow.) Fisch. de Waldh.

Bull. Soc. Nat. Mosc. **40**[1]: 258. 1867.

In petioles of *Viola longipes* Nutt.: *767*, July 22, 1905, Brighton, Big Cottonwood Canyon, 8,750 feet. In petioles and blades of *Viola Nuttalli* Pursh: *1078*, May 16, 1908, City Creek Canyon.

UREDINALES

1. AECIDIUM ABUNDANS Peck,

Bot. Gaz. **3**: 34. 1878.

On leaves of *Symphoricarpos rotundifolius* A. Gray: *260*, Aug. 7, 1903, summit of ridge of Wasatch Mts., near Salt Lake City, 7,825 feet. The specimens of this collection are peculiar in their unusually long peridia. On leaves of *Symphoricarpos vaccinioides* Rydb.: *716*, July 5, 1905, Wasatch Mts., Wasatch Co.; *900a*, July 17, 1906, Pharaoh's Glen, Parley's Canyon.

EXSICCATI: Fungi Utah. *19*.

2. AECIDIUM EUPHORBIAE Pers.

On leaves of *Euphorbia robusta* (Engelm.) Small, (*E. montana robusta* Engelm.): *722*, July 6, 1905, Wasatch mountains, Wasatch Co., at about 9,500 feet altitude. This was found on leaves of

the host together with II and III of *Uromyces Tranzschelii* Syd., and was issued in Fungi Utah. *96* as the aecial stage of *U. andina* Magn.

3. AECIDIUM HYDROPHYLLI Peck,

Ann. Rep. N. Y. State Mus. **26**: 78. 1873.

On *Hydrophyllum capitatum* Dougl.: *393*, June 22, 1904, Wasatch Mts. near Salt Lake City, 6,500 feet; *877*, May 19, 1906, Upper Falls, Provo Canyon, Utah Co. On leaf-blades, petioles and cotyledons of *Hydrophyllum Watsonii* (A. Gray) Rydb.: *648*, June 6, 1905, Red Butte Canyon, 5,600 feet.

EXSICCATI: Fungi Utah. *35*, *36*.

4. AECIDIUM MONOICUM Peck,

Bot. Gaz. **4**: 230. 1879.

On *Arabis Drummondii* A. Gray: *760*, July 22, 1905, Big Cottonwood Canyon, 9,000 feet. This *Aecidium* is probably the aecial stage of *113* on *Trisetum subspicatum* (L.) Beauv. (See Jour. Myc. **12**: 163, July, 1906.) On *Sophia* sp.: *733*, July 8, 1905, Big Cottonwood Canyon. This collection is referred here with some doubt. The peridia are longer and of a darker orange color than those of the *Arabis* host.

EXSICCATI: Fungi Utah. *75*.

5. AECIDIUM PHACELIAE Peck,

Bull. Torrey Club **11**: 49. 1884.

On *Phacelia heterophylla* Pursh: *394*, June 22, 1904. Wasatch Mts., near Salt Lake City, 6,500 feet. On Aug. 26, 1909, nearly defunct aecia were found on this host. Around the host-plants *Bromus* was growing, and a rust was found in II and III on the *Bromus*. On *Phacelia alpina* Rydb.: *861*, Aug. 24, 1905, Silver Lake, Big Cottonwood Canyon, 8,735 feet.

EXSICCATI: Fungi Utah. *31*, *77*.

6. AECIDIUM ROESTELIOIDES Ellis & Ev.

Jour. Myc. **1**: 93. 1885.

On *Sidalcea nervata* A. Nelson: *2092a*, near Gogorza, Summit

Co., Aug. 26, 1909. Nearly defunct. Mrs. Clemens collected fine material here in May.

7. AECIDIUM sp.

On *Thalictrum Fendleri* Engelm.: *450*, July 12, 1904, Red Butte Canyon, 6,000 feet. On *Thalictrum sparsiflorum* Turcz.: *936*, Aug. 25, 1906, Big Cottonwood Canyon, 8,650 feet. The alternate form of this rust is possibly *97*, the *Puccinia* on several species of *Agropyron* and *Elymus*. On numerous occasions I have observed the two growing within a few feet of each other. Among other instances might be cited collection *937* of *Puccinia* on *Agropyron caninum* Beauv.

EXSICCATI: Fungi Utah. *76*. (Distributed under the name of *Aecidium Thalictri-flavi* Wint.)

8. CAEOMA CONFLUENS (Pers.) Schröt. (*Uredo confluens* Pers.)

Krypt. Fl. Schles. 3^1: 376. 1887.

On *Ribes vallicola* Greene, (*R. saxosum* Coville; *R. oxyacanthoides* L.): *682*, June 29, 1905, Big Cottonwood Canyon, 8,500 feet. This is possibly connected with a *Melampsora* found on *Salix phylicifolia* as recorded under *11* of this list. (See Jour. Myc. **12**: 163. July, 1906.)

EXSICCATI: Fungi Utah. *71*.

9. GYMNOSPORANGIUM NELSONI Arth. I,

Bull. Torrey Club **28**: 665. 1901.

On leaves of *Amelanchier alnifolia* Nutt.: *2071*, Aug. 2, 1909, Fish Creek Canyon, western Sevier Co.; *2088a*, Aug. 26, 1909, Gogorza, Summit Co. On July 7, 1904, in City Creek Canyon, a single leaf of *Amelanchier* bearing spermogonia, probably of this species, was taken.

10. HYALOPSORA POLYPODII (Pers.) Magn. (*Uredo Polypodii* Pers.)

Berichte der deutchen Bot. Gesell. **19**: 582. 1901.

On *Filix fragilis* (L.) Underw. (*Cystopteris fragilis* Bernh.): *498*, Aug. 27, 1904, Big Cottonwood Canyon, 9,000 feet. Not uncommon.

EXSICCATI: Fungi Utah. *74*.

Melampsora Bigelowii Thüm. II, III,

Mitth. Forstl. Vers. Oest. **2**: 37. 1879.

On *Salix exigua* Nutt.: *2000*, November 21, 1908, near Salt Lake City. On *Salix lasiandra Fendleriana* Bebb., (*S. lasiandra caudata* Sudw.; *S. Fendleriana* Anders.; *S. pentandra caudata* Nutt.): *318*, II, Sept. 3, 1903, Red Butte Canyon, altitude about 5,500 feet; *632*, III, April 8, 1905, same locality as *318*. (According to Dr. Sydow, this is *M. epitea.*) On *Salix phylicifolia* L., (*S. chlorophylla* Anders.): *846*, Aug. 17, 1905, altitude about 8,600 feet. On *Salix luteosericea* Rydb.: *871*, Oct. 7, 1905, City Creek Canyon. On *Salix cordata Watsoni* Bebb., (*S. lutea* Nutt.; *S. cordata lutea* Bebb.): *1180*, Sept. 12, 1908, City Creek Canyon. On *Salix* sp.: *986*, Sept. 29, 1906, Castilla, Utah Co.

12. Melampsora Lini Desmaz. II,

Pl. Crypt. *2049*. 1850.

On *Linum Lewisii* Pursh: *408*, June 30, 1904, Wasatch Mts. near Salt Lake City. On *Linum Kingii* Wats.: *723*, July 6, 1905, Wasatch Mts., Wasatch Co.

Exsiccati: Fungi Utah. *78*.

13. Melampsora Medusae Thüm. II,

Bull. Torrey Club **6**: 216. 1906.

On *Populus angustifolia* James: *2115*, Oct. 9, 1909, Wasatch Resort, Little Cottonwood Canyon.

14. Melampsora sp. II,

On *Salix schouleriana* Barrett, (*S. Nuttallii* Sarg.; *S. flavescens* Nutt.): *903*, June 17, 1906, Parley's Canyon, altitude about 7,000 feet. Host determined by Dr. Rydberg. This *Melampsora* seems to be entirely different from the other collections on *Salix*. It greatly resembles the rust on *Populus* in its gross characteristics.

15. Melampsorella elatina (Alb. & Schw.) Arth. (*M. cerastii* Schröt.) II,

N. Am. Fl. **7**: 111. 1907.

On *Stellaria borealis* Bibelow, (*Alsine borealis* Britton): *851*,

Aug. 21, 1905, Big Cottonwood Canyon, 8,000 feet. Very rare.

EXSICCATI: Fungi Utah. *127*.

16. MELAMPSOROPSIS PYROLAE (DC.) Arth. (*Chrysomyxa Pirolae* Rost.) II,

Result. Sci. Congr. Bot. Vienne 338. 1906.

On *Pyrola uliginosa* Torr., (*P. rotundifolia uliginosa* Gray): *683*, June 29, 1905, Big Cottonwood Canyon, 8,500 feet. On *Pyrola secunda* L.: *823*, Aug. 10, 1905, Silver Lake, Big Cottonwood Canyon, 8,735 feet.

EXSICCATI: Fungi Utah. *72, 73*.

17. PHRAGMIDIUM AFFINE Syd. I, III,

Ann. Myc. **2**: 29. 1904.

On *Potentilla pulcherrima* Lehm.: *315*, Sept. 3, 1903, Red Butte Canyon, altitude about 6,500 feet. On *Potentilla viridescens* Rydb.: *491*, Aug. 29, 1904, Big Cottonwood Canyon. On *Potentilla glomerata* A. Nelson: *727*, July 6, 1905, "Hot Pots," Wasatch Co., 6,912 feet. On *Potentilla Bakeri* Rydb.: *726*, July 6, 1905, same locality as *727*.

This rust has been collected on other species of *Potentilla* not yet satisfactorily determined.

EXSICCATI: Fungi Utah. *100, 151*. Fungi Columb. *1946*.

18. PHRAGMIDIUM ANDERSONI Shear, II,

Bull. Torrey Club **29**: 453. 1902.

On *Dasiophora fruticosa* (L.) Rydb., (*Potentilla fruticosa* L.): *705*, July 3, 1905, South Fork Big Cottonwood Canyon. Very rare.

19. PHRAGMIDIUM HORKELIAE Garrett, III,

Fungi Utah. 112. Jan. 19, 1907.

On *Horkelia Gordonii* Hook., (*Ivesia Gordoni* T. & G.): *932*, Aug. 17, 1906, Mt. Millicent, Big Cottonwood Canyon, 9,500 feet. Very rare, found only in the type locality.

20. PHRAGMIDIUM JONESII Dietel, I, III,

Hedwigia **44**: 132. 1905.

On *Horkelia Gordonii* Hook., (*Ivesia Gordoni* T. & G.): *703*, July 3, 1905, head of Little Cottonwood Canyon. Very rare.

21. PHRAGMIDIUM MONTIVAGUM Arth. II, III,

Torreya 9: 24. 1909.

On *Rosa Fendleri* Crepin: *446*, July 12, 1904, Red Butte Canyon. On *Rosa Maximiliani* Nels.: *725*, July 6, 1905, Little Snake Creek Canyon, Wasatch Co. On *Rosa grosse-serrata* E. Nelson: *2049*, July 28, 1909, Fish Creek Canyon, western Sevier Co. (Host determined by Dr. Rydberg.) On *Rosa Macounii* Greene: *2032*, July 17, 1909, Emigration Canyon. (Host *2475*, determined by Dr. Rydberg.)

22. PUCCINIA ABERRANS Peck, III,

Bot. Gaz. 4: 217. 1879.

On *Smelowskia americana* Rydb., (*S. calycina* Benth. & Hook.): *773*, July 28, 1905, on side of Mt. Millicent, Big Cottonwood Canyon, 9,800 feet. The type of this species was collected in Utah.

EXSICCATI: Fungi Utah. *79*.

23. PUCCINIA ABSINTHII DC. II, III,

Encycl. 8: 245. 1808.

On leaves of *Artemisia dracunculoides* Pursh: *476*, Aug. 5, 1904, City Creek Canyon, Wasatch Mts. at about 6,000 feet. On leaves and stems of *Artemisia nova* A. Nelson: *2030*, July 17, 1909, Emigration Canyon. On leaves and stems of *Artemisia tridentata* Nutt.: *223*, June 19, 1903, Wasatch Mts., Salt Lake Co., altitude about 5,800 feet; *266a,* Aug. 11, 1903, Big Cottonwood Canyon, 7,000 feet; *721a,* July 6, 1905, Wasatch Mts., Wasatch Co.; *2060*, Aug. 2, 1909, Fish Creek Canyon, western Sevier Co.

EXSICCATI: Fungi Utah. *79, 80, 81*.

24. PUCCINIA AEMULANS Syd. (*P. Gymnolomiae* Dietel & Holw.) I, II, III,

Ann. Myc. 4: 31. 1906.

On stems and leaves of *Gymnolomia multiflora* Benth. & Hook.: *230*, I, II, June 27, 1903, Wasatch Mts., near Salt Lake City: *230a,* Sept. 3, 1903, Red Butte Canyon. Quite common.

EXSICCATI: Fungi Utah. *15, 16, 42*.

25. PUCCINIA AGROPYRI Ellis & Ev. I, II, III,
Jour. Myc. 7: 131. 1892.

On *Agropyron Smithii* Rydb., (*A. occidentalis* Scribn.): *1166*, II, III, Sept. 1, 1908, Beck's Hot Springs, near Salt Lake City. On *Clematis ligusticifolia* Nutt.: *2053*, I (=*Aecidium Clematidis* DC.) July 29, 1909, Clear Creek Canyon, western Sevier Co. Prof. C. P. Smith collected this stage on the same host in Cache Co.

EXSICCATI: Fungi Utah. *152*.

26. PUCCINIA ARNICALIS Peck, II, III,
Bot. Gaz. **6**: 227. 1881.

On *Arnica cordifolia* Hook.: *304*, II, III. Aug. 17, 1903, north fork Big Cottonwood Canyon, at about 9,000 feet; *711*, II only, July 4, 1905, same locality. On *Arnica paniculata* A. Nelson: *513*, II, III, Aug. 29, 1905, Big Cottonwood Canyon near Brighton, 8,700 feet altitude. (In Fungi Utah. *27*, the host of this collection was given as *A. rhizomata*.) On *Arnica subplumosa sylvatica* (Greene) A. Nelson: *933*, Aug. 17, 1906, Big Cottonwood Canyon, 9,200 feet. Host 1975, determined by A. Nelson.

The original description says: "Teleutospores intermingled with the stylospores." This is true if the specimens are taken late in the season; but those collected when the rust first appears will have uredosori only, as shown by Fungi Utah. *26*.

EXSICCATI: Fungi Utah. *25*, *26*, *27*; Fungi Columb. *1846*.

27. PUCCINIA ASTERIS Duby, III,
Bot. Gall. **2**: 888. 1830.

On leaves of *Aster adscendens* Lindl.: *225*, June 22, 1903, City Creek Canyon. On leaves of *Aster Eatoni* (A. Gray) Howell: *477*, Aug. 5, 1904, City Creek Canyon. On leaves of *Aster arenarioides* D. C. Eaton: *847*, Aug. 20, 1904, Big Cottonwood Canyon, altitude about 6,600 feet. On leaves of *Machaeranthera canescens* (Pursh) A. Gray, (*Aster canescens* Pursh): *459*, July 12, 1904, Red Butte Canyon.

EXSICCATI: Fungi Utah. *41*, *128*, *153*.

28. PUCCINIA BALSAMORRHIZAE Peck, II, III,

Bull. Torrey Club **11**: 49. 1884.

On *Balsamorrhiza sagittata* (Pursh) Nutt.: *390*, II, June 17, 1904, near Salt Lake City, 5,000 feet; *461*, III, July 20, 1904, near Salt Lake City, 5,000 feet; *644*, II, May 14, 1905, on scale-like prophylla, near Salt Lake City, 4,600 feet. Quite common on this host. On *Balsamorrhiza macrophylla* Nutt.: *456*, July 12, 1904, Red Butte Canyon, 5,500 feet.

EXSICCATI: Fungi Utah. *61*, *62*, *63*, *154*.

29. PUCCINIA CALOCHORTI Peck, I, III,

Bot. Gaz. **6**: 228. 1881.

On *Calochortus Nuttallii* T. & G.: *180*, I, May 2, 1903, Salt Lake City, 4,575 feet; *194*, III, May 14, 1903, Salt Lake City, 4,575 feet.

The type of this species was collected in Utah by Prof. M. E. Jones.

EXSICCATI: Fungi Utah. *90*; Fungi Columb. *1953*.

30. PUCCINIA CARDUORUM Jacky, II, III,

Zeitschrift fur Pflanzen Krankheiten **9**: 288. 1899.

On *Carduus leiocephalus* (Eat.) Heller: *494*, II, Aug. 22, 1904, head of Big Cottonwood Canyon, 9,400 feet.

EXSICCATI: Fungi Utah. *69*.

31. PUCCINIA CARICINA DC.? III,

Fl. Fr. **6**: 60. 1815.

On *Carex Hoodii* Boott, (*C. muricata confixa* Bailey): *317*, Sept. 3, 1903, Red Butte Canyon. There is some doubt as to the determination of this rust. Dr. Arthur thinks that it may possibly be *P. Caricis-Asteris*. The sedge was determined by Dr. Theo. Holm.

32. PUCCINIA CARICIS (Schum.) Schröt. I, II, III, (*P. Urticae* Lagerh.).

Krypt. Fl. Schles. **3**: 327. 1889.

On *Urtica gracilis* Ait.: *1008*, I, June 29, 1907, Parley's Canyon, altitude about 5,100 feet. On *Carex lanuginosa* Michx.:

1009, III, June 29, 1907, same locality as *1008*. Much weathered material, and a few fresh sori; *1055*, III, Aug. 28, 1907, same locality as *1008*, abundance of fresh material. The *Carex* plants grew by the side of the nettles. This collection is from the same clump of plants as *1009*. On *Carex rostrata* Stokes: *1121*, II, III, Aug. 11, 1908, Gogorza, Summit Co., 6,329 feet altitude.

EXSICCATI: Fungi Utah. *129*, *130*, *172*.

33. PUCCINIA CARICIS-ASTERIS Arth., I, III,
Jour. Myc. 8: 54. 1902.

On *Aster ciliomarginatus* Rydb.: *746*, I, July 11, 1905, Big Cottonwood Canyon, 8,750 feet. Host *1603*, determined by Dr. Rydberg. On *Aster Fremontii* A. Gray: *844*, I, Aug. 17, 1905, Big Cottonwood Canyon, host *1631*, altitude about 8,700 feet. On *Aster apricus* (A. Gray) Rydb.: *938*, I, Aug. 25, 1906, Big Cottonwood Canyon, host *2008*, determined by Dr. Rydberg. On *Aster* sp. nov.: *939*, I, Aug. 25, 1906, Big Cottonwood Canyon, host *2009*. On *Carex festiva* Dewey: *827*, III, Aug. 12, 1905, Big Cottonwood Canyon, 8,750 feet. The *Carex* plants were growing around in these several collections.

EXSICCATI: Fungi Utah. *65*, *66*, *131*, *155*.

34. PUCCINIA CINEREA Arth. I, II, III,
Bull. Torrey Club 34: 583. 1907.

On *Ranunculus Cymbalaria* Pursh, (*Oxygraphis Cymbalaria* Prantl.): *984*, I, Sept. 29, 1906, Thistle Junction, Utah Co., 5,033 feet. That this is the aecial stage of *P. cinerea* is proved by Dr. Arthur's culture work for 1908. At the time this collection was made, the *Ranunculus* was growing in with *Sporobolus filiformis* (Thurb.) Rydb. The grass was infected with a rust (No. *100* of this list), and it was thought at the time that there might be some connection between these two. Issued in Fungi Utah. as *Aecidium Ranunculacearum* DC.? On *Poa Fendleriana* (Steud.) Vasey: *1149*, II, III, Aug. 29, 1908, Beck's Hot Springs, near Salt Lake City.

EXSICCATI: Fungi Utah. *126*, *156*.

35. PUCCINIA CIRSII Lasch,

Rabenh. Fungi Eur. *89*.

On *Carduus acaulescens* (A. Gray) Rydb., (*Cnicus Drummondii acaulescens* A. Gray): *266*, Aug. 11, 1903, Big Cottonwood Canyon, 8,000 feet. Host *2042*, determined by Dr. Rydberg. On *Carduus* sp.: *721*, July 6, 1905, Provo Valley, near Midway, Wasatch Co.

EXSICCATI: Fungi Utah. *132*.

36. PUCCINIA CIRSII-LANCEOLATI Schröt. I, II, III,

Krypt. Fl. Schles. **3**: 317. 1889.

On *Carduus lanceolatus* L.: *215*, II, June 13, 1903, Salt Lake City, 4,450 feet; *336*, III, Dec. 25, 1903, Salt Lake City, 4,450 feet; *340*, I, April 24, 1904, Salt Lake City, 4,450 feet. This is the first recorded field collection in America of the aecial stage, although Dr. Kellerman previously obtained it from cultures.

EXSICCATI: Fungi Utah. *88*.

37. PUCCINIA CLAYTONIATA (Schw.) Syd. (*P. Mariae-Wilsoni* Clinton), I, III,

Monog. Ured. **1**: 561. 1903.

On *Montia sibirica* (L.) Howell, (*Claytonia sibirica* L.): *866*, III, Aug. 26, 1905, Big Cottonwood Canyon, 8,650 feet; *911*, I, Aug. 3, 1906, Big Cottonwood Canyon, 8,650 feet.

EXSICCATI: Fungi Utah. *67*.

38. PUCCINIA COMANDRAE Peck, III,

Bull. Torrey Club **11**: 49. 1884.

On leaves and stems of *Comandra pallida* A. DC.: *246*. July 22, 1903, City Creek Canyon.

EXSICCATI: Fungi Utah. *17*; Fungi Columb. *1957*.

39. PUCCINIA CONFERTA Dietel & Holw.

Erythea **1**: 250. 1893.

On *Artemisia Hookeriana* Besser.: *2047*, July 28, 1909, Fish Creek Canyon, western Sevier Co.

40. PUCCINIA CONFLUENS Syd. III,
Monog. Ured. **1**: 81. 1902.

On stems and leaves of *Erigeron macranthus* Nutt.: *252*, July 27, 1903, Wasatch Mts., near Salt Lake City, at about 6,700 feet altitude.

EXSICCATI: Fungi Utah. *89*.

41. PUCCINIA CRANDALLII Pammel & Hume, II, III,
Davenport Acad. Sci. **7**: 250. 1899.

On *Festuca confinis* Vasey: *2024*, II, July 17, 1909, Emigration Canyon; *2103*, III, Oct. 2, 1909, Emigration Canyon. This is doubtless the telial stage of *Aecidium abundans*. The host is found in the same general altitude as that of the *Aecidium*, and this rust follows the one on *Symphoricarpos*.

42. PUCCINIA CREPIDIS-ACUMINATAE Syd. II, III,
Oesterr. Bot. Zeitschr. **51**: 17. 1901.

On *Crepis acuminata* Nutt.: *386*, II, June 17, 1904, Wasatch Mts. near Salt Lake City, altitude 4,750 feet; *674*, III, June 22, 1905, Mill Creek Canyon, Salt Lake Co. On *Crepis glauca* (Nutt.) T. &. G.: *1185*, III, Sept. 26, 1908, Beck's Hot Springs, near Salt Lake City. On *Crepis occidentalis* Nutt.: *183*, II, May 2, 1903, Salt Lake City, 4,500 feet; *380*, III, June 15, 1904, Salt Lake City, 4,500 feet. On *Crepis scopulorum* Coville: *661*, II, III, June 9, 1905, Wasatch Mts., near Salt Lake City. The rust occurs indiscriminately both on leaves and on stems. (Host given as *C. rostrata* in Fungi Utah. *46*.) On *Crepis* sp. nov.: *391*, June 17, 1904, Wasatch Mts., near Salt Lake City.

EXSICCATI: Fungi Utah. *20, 46, 133, 157;* Fungi Columb. 1959. (Issued as *P. crepidicola* in the latter.)

43. PUCCINIA CRESSAE (DC.) Lagerh. I, III, (*P. cretica* Holw.).
Bot. Soc. Brot. **7**: 131. 1889.

On *Cressa Truxillensis* H.B.K.: *660*, I, June 9, 1905, Beck's Hot Springs, Salt Lake Co., altitude about 4,250 feet; *870*, III, Sept. 23, 1905, same locality. Judging from the marked hyper-

trophy of the aecia-producing stems, the mycelium is probably perennial. The fresh specimens of aecia also have the strong odor characteristic of those produced from perennial mycelia.

EXSICCATI: Fungi Utah. *91, 158.*

44. PUCCINIA CURTIPES Howe, III,

Bull Torrey Club **5**: 3. 1874.

On *Heuchera rubescens* Torr.: *837,* Aug. 15, 1905, head of Big Cottonwood Canyon, about 9,000 feet altitude; *1062,* Sept. 28, 1907, American Fork Canyon, Utah Co. On *Heuchera utahensis* Rydb., (*H. parvifolia* Nutt. in part): *209,* June 10, 1903, Wasatch Mts., near Salt Lake City, 6,000 feet. On *Mitella stenopetala* Piper., (*Ozomelis stenopetala* Rydb.): *261,* Aug. 7, 1903, Black Mountain, Salt Lake Co., altitude 7,500 feet.

EXSICCATI: Fungi Utah. *39, 40, 134.*

45. PUCCINIA DOUGLASII Ellis & Ev. III,

Proc. Acad. Phila. **1893**: 152. 1893.

On *Phlox depressa* (E. Nels.): *2054,* July 31, 1909, Fish Creek Canyon, western Sevier Co. Type collected by M. E. Jones at Detroit, Utah.

46. PUCCINIA DRABAE Rudolphi, III,

Linnaea **4**: 115. 1829.

On leaves, stems and calyx-lobes of *Draba pectinata* (S. Wats.): *920,* Aug. 11, 1906, Mt. Minnie, Little Cottonwood Canyon, Salt Lake Co., 10,900 feet. Very rare.

EXSICCATI: Fungi Utah. *116.*

47. PUCCINIA EFFUSA Dietel & Holw. I, III,

Erythea **3**: 81. 1895.

On *Viola canadensis Rydbergii* (Greene) House, (*V. Rydbergii* Greene): *817a,* Aug. 26, 1905, near Silver Lake, Big Cottonwood Canyon, 8,625 feet. This is figured in North American Uredineae, *105e.* According to Mr. Holway, this is *P. Violae* rather than *P. effusa.*

EXSICCATI: Fungi Utah. *54.*

48. PUCCINIA ELLISII De-Toni, II, III,

Sacc. Syll. **7**: 651. 1888.

On *Cynomarathrum Nuttallii* Coult. & Rose, (*Peucedanum graveolens* Wats.): *259*, III, Aug. 7, 1903, Wasatch Mts., Salt Lake Co., 7,900 feet. A few spermogonia were found. *719*, II, July 5, 1905, Wasatch Mts., Wasatch Co., 9,500 feet.

EXSICCATI: Fungi Utah. *9, 51*.

49. PUCCINIA EPILOBII-TETRAGONI (DC.) Wint. I, II, III,

Rabenh. Krypt. Fl. **1**^{1}: 214. 1884.

On *Epilobium paniculatum* Nutt.: *234*, II, III, July 2, 1903, City Creek Canyon, altitude about 5,600 feet; *730*, II, III, July 6, 1905, Wasatch Co.; *926*, I, III, Aug. 13, 1906, Big Cottonwood Canyon, 8,700 feet. Spores of this collection are figured as *113b* in North American Uredineae.

EXSICCATI: Fungi Utah. *86, 110*.

50. PUCCINIA EXPANSA Link, III,

in Willd. Sp. Pl. **6**^{2}: 75. 1825.

On *Senecio dispar* A. Nelson: *738*, July 10, 1905, on side of Mt. Millicent, Big Cottonwood Canyon, 10,000 feet.

EXSICCATI: Fungi Utah. *102*. (Issued under the name of *P. recedens*.)

51. PUCCINIA FERGUSSONI Berk. & Br. III,

Ann. Nat. Hist. **15**: 35. 1875.

On *Viola blanda* L.: *797*, Aug. 2, 1905, near Silver Lake, Big Cottonwood Canyon, 8,735 feet.

EXSICCATI: Fungi Utah. *53*.

52. PUCCINIA GARRETTII Arth. X, III,

Bull. Torrey Club **32**: 41. 1905.

On *Carex nebraskensis* Dewey, (*C. Jamesii* Torr.): *614*, X, Oct. 11, 1904, Salt Lake City, 4,250 feet: *633*, X, III, April 8, 1905, Red Butte Canyon, 6,000 feet. Dr. Arthur calls attention to the fact that the amphispores of this species have the thinnest walls of any known species. Of a dozen or more collections, all

seem to be on *C. nebraskensis.* Hosts determined by Dr. Holm.

EXSICCATI: Fungi Utah. *44, 45;* Fungi Columb. *1759.* (Issued in the latter as *P. Caricis.*) The host plant is *C. nebraskensis* in all of these collections.

53. PUCCINIA GAYOPHYTI Billings, I, II, III,
U. S. Geol. Explor. Fortieth Parallel **5**: 414. 1871.

On *Gayophytum caesium* Nutt., (*G. racemosum* T. & G.): *275,* III, Aug. 13, 1903, Big Cottonwood Canyon; *894,* II, III, July 12, 1906, Red Butte Canyon; *2062,* Aug. 2, 1909, Fish Creek Canyon, Sevier Co. On *Gayophytum intermedium* Rydb.: *489,* III, Aug. 21, 1904, Big Cottonwood Canyon, 7,900 feet. On *Gayophytum pumilum* Wats.? *691,* I, III, June 29, 1905, Big Cottonwood Canyon, 8,500 feet. On *Gayophytum ramosissimum* T. & G.: *714,* I, III, July 8, 1905, Wasatch Mts., Wasatch Co., 8,500 feet. On *Gayophytum lasiospermum* Greene: *452,* July 12, 1904, Red Butte Canyon. Host determined by Dr. Rydberg.

EXSICCATI: Fungi Utah. *49, 50;* Fungi Columb. *1851.*

54. PUCCINIA GILIAE Ellis & Hark. III,
Bull. Calif. Acad. **1**: 34. 1884.

On *Phlox caespitosa* Nutt.: *782,* July 29, 1905, Mt. Majestic, Big Cottonwood Canyon, 9,500 feet.

EXSICCATI: Fungi Utah. *28.*

55. PUCCINIA GRAMINIS Pers. (*P. poculiformis* Wett.)
II, III,
Tent. Disp. Meth. Fung. in Romer's Neues Mag. 39. 1797

On *Triticum vulgare* L.: *983,* Sept. 29, 1906, near Castilla, Utah Co. This collection is unusual in that the telia are mostly on the leaves instead of upon the stems. On *Agropyron tenerum* Vasey: *1175,* III, Sept. 4, 1908, near Salt Lake City. On *Beckmannia erucaeformis* (L.) Host: *1174,* II, Sept. 4, and *1191,* III, Oct. 17, Salt Lake City. On *Elymus condensatus* Presl.: *1193,* II, III, Oct. 17, 1908, near Salt Lake City. On *Elymus canadensis* L.: *2001,* III, Feb. 22, 1909, near Salt Lake City. On *Sitanion glaber* J. G. Smith: *1176,* III, Sept. 4, 1908, near Salt

Lake City. On *Avena sativa* L.: *2012*, II, Oct. 2, 1909, Emigration Canyon.

EXSICCATI: Fungi Utah. *160*.

56. PUCCINIA GUTIERREZIAE Ellis & Ev. III,

Proc. Acad. Phila. 1893: 152. 1893.

On *Gutierrezia Sarothrae* (Pursh) Berk. & Rav. (*G. Euthamiae* T. & G.): *474*, Aug. 5, 1904, City Creek Canyon. Dr. Arthur thinks that this rust may possibly be the same as *P. Grindeliae* Peck. Although *Grindelia squarrosa* is a very abundant weed here, as yet the writer has failed to find any rust associated with it.

The type of this rust was collected by M. E. Jones at Digway, Utah, June, 1892.

EXSICCATI: Fungi Utah. *47*.

57. PUCCINIA HARKNESSII Vize,

Grevillea 7: 11. 1878.

On *Stephanomeria minor* Nutt.: *2050*, July 29, 1909. Clear Creek Canyon, western Sevier Co.

58. PUCCINIA HELIANTHELLAE (Peck) Arth. II, III,

Bull. Torrey Club 31: 4. 1904.

On *Helianthella uniflora* T. & G.: *712*, II, July 5, 1905, Big Cottonwood Canyon, 9,000 feet; *781*, III, July 29, 1905, Big Cottonwood Canyon, 8,650 feet.

EXSICCATI: Fungi Utah. *55, 56*.

59. PUCCINIA HELIANTHI Schw. II, III,

Syn. Fung. Carol. 73. 1822.

On *Helianthus lenticularis* Dougl., (*H. annuus* A. Gray in part): *982*, Sept. 29, 1906, near Castilla, Utah Co., 5,033 feet; *1150*, II, Aug. 25, 1908, Beck's Hot Springs, near Salt Lake City, altitude about 4,250 feet.

EXSICCATI: Fungi Utah. *107, 161*.

60. PUCCINIA HEMISPHERICA (Peck) Ellis & Ev. I, II, III,
N. Am. Fungi *3144*.

On leaves and stems of *Lactuca pulchella* DC.: *1007*, June 29, 1907, near Salt Lake City, 4,450 feet. The aecia-producing mycelia cause marked hypertrophy of the tissues of the host, and the affected plants grow taller and more slender.

EXSICCATI: Fungi Utah. *22, 136*.

61. PUCCINIA HETERANTHA Ellis & Ev. I, II, III,
Erythea **1**: 204. 1893.

On *Taraxia subacaulis* (Pursh) Rydb., (*Oenothera heterantha* Nutt.): *688*, I, II, June 29, 1905, Big Cottonwood Canyon, 8,600 feet; *912*, III, Aug. 3, 1906, Big Cottonwood Canyon, 8,600 feet. Mr. Holway has compared this with the type, and finds that these specimens have more regular spores than those of the type.

EXSICCATI: Fungi Utah. *92, 162*.

62. PUCCINIA HEUCHERAE (Schw.) Dietel, III,
Ber. Deutsch. Bot. Gesel. **9**: 42. 1891.

On *Mitella pentandra* Hook. (*Pectiantia pentandra* Rydb.): *271*, Aug. 13, 1903, Big Cottonwood Canyon, 8,700 feet. On *Saxifraga arguta* D. Don. (*Micranthes arguta* Small; *Saxifraga punctata* Auct. Amer.—not L.): *303*, Aug. 17, 1903, Big Cottonwood Canyon, 8,900 feet. On *Mitella stenopetala* Piper. (*Ozomelis stenopetala* Rydb.): *521*, September 2, 1904, Big Cottonwood Canyon, at about 8,900 feet.

All the above are what are usually separated under the name of *P. saxifrage* Schlecht. Common.

EXSICCATI: Fungi Utah. *58, 108*.

63. PUCCINIA HIERACII (Schum.) Mart. III,
Prod. Fl. Mosq. 226. 1817.

On *Hieracium griseum* Rydb.: *519*, Aug. 30, 1904, near Lake Solitude, Big Cottonwood Canyon, 9,000 feet. Not common.

EXSICCATI: Fungi Utah. *85*.

64. PUCCINIA HOLBOELLII Hornem. III,
Fungi Groenl. 534. 1888.

On leaves of *Arabis retrofracta* Graham, (*A. Holboellii* of Coulter's Manual): *169*, April 25, 1903, Salt Lake City, 4,500 feet. Abundant. This rust causes marked hypertrophy of the stem and leaves of its host. Although the writer has made many collections of this rust in various localities, he has never found an aecial stage in any way connected with it.

EXSICCATI: Fungi Utah. *4*.

65. PUCCINIA HYDROPHYLLI Peck & Clinton,
Ann. Rep. N. Y. State Mus. **30**: 54. 1877.

On *Hydrophyllum capitatum* Dougl.: *181*, May 2, 1903, Salt Lake City, 4,500 feet. Abundant. On *Hydrophyllum Watsonii* (A. Gray) Rydb.: *344*, May 21, 1904, Red Butte Canyon, Salt Lake Co. Not common on this host.

EXSICCATI: Fungi Utah. *30*, *81*; Fungi Columb. *1855*.

66. PUCCINIA HYSTERIIFORMIS Peck, III,
Bot. Gaz. **6**: 276. 1881.

On leaves, stems and rarely on calyx-lobes of *Arenaria uintahensis* A. Nelson: *211*, June 10, 1903, Wasatch mountains near Salt Lake City. The type of this species was collected in Utah on *Arenaria verna* Hort.

EXSICCATI: Fungi Utah. *14*; Fungi Columb. *1963*.

67. PUCCINIA INCLUSA Syd. II, III,
Monogr. Ured. **1**: 1902.

On leaves and stems of *Carduus undulatus* Nutt.: *376*, June 15, 1904, near Salt Lake City.

EXSICCATI: Fungi Utah. *93*.

68. PUCCINIA INTERMIXTA Peck, I, III,
Bot. Gaz. **4**: 231. 1879.

On leaves and stems of *Iva axillaris* Pursh: *1087*, May 23, 1908, near mouth of Parley's Canyon; *2072*, Aug. 6, 1909, Manti, San Pete Co.

The mycelium causes hypertrophy of the tissues of the host, the affected plants seldom flowering. The mycelium is probably perennial.

EXSICCATI: Fungi Utah. *163*.

69. PUCCINIA JONESII Peck, I, III,

Bot. Gaz. **6**: 226. 1881.

On *Lomatium platycarpum* (Torr.) Coult. & Rose, (*Peucedanum simplex* Nutt.): *178*, I, April 25, 1903, Salt Lake City, 4,500 feet; *195*, III, May 15, 1903, same locality as *178*. Not very common on this host. On all chlorophyll-bearing parts of *Leptotaenia Eatoni* Coult. & Rose: *185*, I, May 2, 1903, Salt Lake City, 4,500 feet; *364*, I, III, June 3, 1904, Farmington Canyon, Davis Co.; *395*, I, III, June 22, 1904, Wasatch mountains near Salt Lake City; *717*, I, III, July 5, 1905, Wasatch Co. Very common on this host. Type collected in Utah by M. E. Jones.

EXSICCATI: Fungi Utah. *5, 6, 7, 8;* Fungi Columb. *1966, 1967, 2063*.

70. PUCCINIA LEVEILLEI Mont. (*P. Geranii-silvatica* Karst.)

Gay, Hist. de Chile **8**: 41. 1852.

On leaf-blades and petioles of *Geranium Fremontii* Torr.: *650*, June 6, 1905, Red Butte Canyon, altitude about 6,000 feet. This was erroneously given in Fungi Utah. as on *G. venosum,* the name being intended for *G. nervosum.* On *Geranium Richardsonii* Fisch. & Traut.: *908*, Aug. 1, 1906, near Silver Lake, Big Cottonwood Canyon, 8,750 feet.

EXSICCATI: Fungi Utah. *88, 101*.

71. PUCCINIA LIGUSTICI Ellis & Ev. III,

Bull. Torrey Club **22**: 363. 1895.

On *Carum Gairdneri* Gray: *190,* on seedlings, May 9, 1903, Wasatch mountains near Salt Lake City. On *Carum Garrettii* A. Nelson: *658a,* June 9, 1905, Wasatch Mts., Salt Lake Co. On *Ligusticum filicinum* S. Wats.; *805*, Aug. 4, 1905, Big Cottonwood Canyon near Silver Lake, 8,650 feet.

In Aug. 1904, a single leaf bearing the sorus of some *Puccinia*

was collected in City Creek Canyon. This may have been this *Puccinia* on *Oxypolis Fendleri* (A. Gray) Heller (*Archemora Fendleri* A. Gray). The specimen having been mislaid, accurate determination either of host or rust is now impossible (*479a*).

EXSICCATI: Fungi Utah. *57*.

72. PUCCINIA LITHOPHRAGMAE Holw. III,

N. Am. Uredineae **1**: 51. 1906.

On *Lithophragma parviflora* (Hook.) Nutt., (*Tellima parviflora* Hook.): *189*, May 9, 1903, Wasatch mountains near Salt Lake City. Often found on base of petioles beneath the surface of the ground. Figured on Plate 21 of Holway's North American Uredineae.

EXSICCATI: Fungi Utah. *164*.

73. PUCCINIA LOBATA Berk. & Curt. III,

Grevillea **3**: 54. 1874.

On *Sida hederacea* (Dougl.) Torr.: *1167*, Sept. 1, 1908, Beck's Hot Springs near Salt Lake City.

EXSICCATI: Fungi Utah. *164*.

74. PUCCINIA MAGNOECIA Ellis & Ev. III,

Bull. Torrey Club **22**: 59. 1895.

On *Aster adscendens* Lindl.: *420*, July 7, 1904, City Creek Canyon, 5,100 feet altitude.

EXSICCATI: Fungi Utah. *64*.

75. PUCCINIA MALVACEARUM Bertero. III,

Mont. in Gay, Hist. Chile **8**: 43. 1852.

On leaves, stems and calyx-lobes of *Malva rotundifolia* L.: *198*, May 15, 1903, Liberty Park, Salt Lake City; *1065*, Sept. 28, 1907, American Fork, Utah Co. On leaves and stems of *Althea rosea* Cav.: *367*, June 5, 1904, Salt Lake City; *1090*, July 16, 1908, Salt Lake City, on white variety of hollyhock. In the earlier part of the season, these seem to be the most susceptible.

EXSICCATI: Fungi Utah. *105*, *165*.

76. PUCCINIA MENTHAE Pers. III,

Syn. Fung. 227. 1801.

On *Mentha canadensis* L.: *2121*, Oct. 16, 1909, Idlewild, Ogden Canyon, Weber Co.

77. PUCCINIA MERTENSIAE Peck, III,

Bot. Gaz. **6**: 227. 1881.

On *Mertensia ciliata* (Torr.) Don.: *763*, July 22, 1905, Big Cottonwood Canyon. Host *1510*, determined by Dr. Rydberg. On *Mertensia polyphylla* Greene: *762a*, July 22, 1905, Big Cottonwood Canyon, altitude about 9,000 feet. Host *1513*, determined by Dr. Rydberg. On *Mertensia* sp. nov., related to *M. intermedia*: *765a*, July 22, 1905, Big Cottonwood Canyon. The leaves infected by the rust were taken from the plant sent to Dr. Rydberg for determination. (Host *1516*.) On *Lappula floribunda* (Lehm.) Greene, (*Echinospermum floribundum* Lehm.): *737*, July 10, 1905, near Lake Phoebe, Big Cottonwood Canyon, 9,000 feet. On *Mertensia arizonica* Greene: *695*, June 30, 1905, Big Cottonwood Canyon.

Common on the *Mertensia*, but very rare on *Lappula*, notwithstanding the abundance of the latter plant. These species of *Mertensia* have been called *M. Siberica* in much of the material coming from the West.

EXSICCATI: Fungi Utah. *166*.

78. PUCCINIA MONARDELLAE Dudley & Thompson,

Jour. Myc. **10**: 53. 1904.

On *Monardella odoratissima* Benth.: *2113*, Oct. 10, 1909, near Wasatch Resort, Little Cottonwood Canyon.

79. PUCCINIA MONTANENSIS Ellis,

Jour. Myc. **5**: 67. 1889.

On *Elymus condensatus* Presl.: *2111*, Oct. 2, 1909, Emigration Canyon.

80. PUCCINIA MUTABILIS Ellis & Gall. (*P. Blasdalei* Dietel & Holw.) I, II, III,

Jour. Myc. **5**: 67. 1889.

On *Allium acuminatum* Hook.: *363*, June 3, 1904, Wasatch Mountains near Farmington, Davis Co., at about 5,700 feet altitude. The upper part of the leaf, bearing the aecia, withers before the uredinia and telia are produced on about the middle of the leaf. Not common. This rust is distinguished from the European *P. Alliorum* by its having aecia.

EXSICCATI: Fungi Utah. *83*. (Issued as *P. Alliorum.*)

81. PUCCINIA OSMORRHIZAE (Peck) Cooke & Peck, I, II, III,

Ann. Rep. N. Y. State Mus. **29**: 73. 1878.

On *Washingtonia divaricata* Britton: *237*, III, July 2, 1903, City Creek Canyon, 5,500 feet; *657*, I and *658*, II, June 9, 1905, same locality as *237*, (in Fungi Utah., the host of *237* was given as *W. nuda*). On *Washingtonia obtusa* Coult. & Rose, (*Osmorrhiza nuda* Porter, not Torr.): *2037*, I, II, III, Aug. 19, 1909, Big Cottonwood Canyon near Silver Lake. On *Washingtonia occidentalis* (Nutt.) Coult. & Rose: *2042*, III, July 21, 1909, Red Butte Canyon.

EXSICCATI: Fungi Utah. *21*, *32*, *33*.

82. PUCCINIA OXYRIAE Fuckel, III,

Jahrb. Nassauischen Ver Naturk. **29**: 14. 1875.

On *Oxyria digyna* (L.) Camptd.: *499*, Aug. 24, 1904, Big Cottonwood Canyon, 9,410 feet. Very rare.

83. PUCCINIA PALLIDO-MACULATA Ellis & Ev. III,

N. A. Fungi *2234*. 1889.

On *Saxifraga arguta* D. Don., (*S. punctata* Auct. Amer.; *Micranthes arguta* Small): *272*, Aug. 13, 1903, Big Cottonwood Canyon, 9,505 feet.

EXSICCATI: Fungi Utah. *34*.

84. PUCCINIA PARNASSIAE Arth. III,

Bull. Torrey Club **31**: 3. 1904.

On leaves and rarely on peduncles of *Parnassia fimbriata* Banks: *288*, Aug. 15, 1903, Big Cottonwood Canyon, 9,400 feet.

EXSICCATI: Fungi Utah. *24*.

85. PUCCINIA PATTERSONIANA Arth.

Bull. Torrey Club **33**: 29. 1906.

On *Elymus condensatus* Presl: *1142*, Aug. 21, 1908, Parley's Canyon.

86. PUCCINIA PIPERI Ricker? II, III,

Jour. Myc. **11**: 114. 1905.

On *Festuca elatior* L.: *892*, July 12, 1906, Red Butte Canyon. This was sent to Dr. Arthur for determination, but because of the immature condition of the material, it could not be named with certainty.

87. PUCCINIA PLUMBARIA Peck, I, III,

Bot. Gaz. **6**: 228. 1881.

On *Gilia Nuttallii* A. Gray: *268*, I, Aug. 13, 1903, Big Cottonwood Canyon near Lake Catherine, 9,600 feet; *510*, I, III, Aug. 27, 1904, Big Cottonwood Canyon, 9,525 feet. On *Microsteris micrantha* (Kellogg) Greene, (*Collomia gracilis* Douglas): *187*, III, May 2, 1903, Salt Lake City; *2061*, Aug. 2, 1909, Fish Creek Canyon, western Sevier Co. So far the writer has failed to find aecia on this host, the telial stage being contemporaneous with the aecia on *Phlox*. Moreover, the telia on *Microsteris* are very confluent often continuously occupying the the entire stem, a habit not found on the other hosts. Then too, *Microsteris* is an annual, and the aecial mycelium on *Phlox* is doubtless a perennial, as is evidenced by the hypertrophied leaves of the host and by the strong "slippery-elm" odor of the aecia. The form on *Microsteris* is probably a distinct species which produces telia only. On *Phlox longifolia* Nutt.: *168*, I, on leaves of the new growth, April 25, 1903, Salt Lake City; *212*, III, June 12, 1903, Salt Lake City.

An abundant species. Type collected by M. E. Jones in Utah.

EXSICCATI: Fungi Utah. *1, 2, 3, 37, 38;* Fungi Columb. *1861, 1970.*

88. PUCCINIA POARUM Niels, II,

Bot. Tidsskr. **3**: 26.

On *Catabrosa aquatica* (L.) Beauv.: *447*, July 12, 1904, Red Butte Canyon at about 6,000 feet. On *Poa reflexa* V. & S.: *293*, Aug. 16, 1903, Big Cottonwood Canyon, 8,870 feet. On *Poa pratensis* L.: *971*, Salt Lake City, 4,300 feet.

EXSICCATI: Fungi Utah. *87, 103, 104.*

89. PUCCINIA POROMERA Holw. sp. nov. ined. III,

On *Angelica dilatata* A. Nelson: *255*, July 31, 1903, near Upper Falls Provo Canyon, Utah Co.; *449*, July 12, 1904, Red Butte Canyon.

This rust is peculiar in that it has the germ-pores of both cells at the septum. Field observations lead the writer to the conclusion that the rust has only the one stage.

90. PUCCINIA PUNCTATA Link, III,

Mag. Naturf. Freunde **8**: 30. 1816.

On *Galium triflorum* Michx.: *974*, Sept. 13, 1906, Parley's Canyon, at about 6,500 feet.

EXSICCATI: Fungi Utah. *114.*

91. PUCCINIA QUADRIPORULA Arth.

Bull. Torrey Club **34**: 386. 1907.

On *Carex* sp. (sterile plants): *1056*, Aug. 28, 1907, Parley's Canyon.

EXSICCATI: Fungi Utah. *167.*

92. PUCCINIA RANUNCULI Blytt, III, (*P. Nuttallii* Ellis & Ev.),

Christiania Vidensk. Forh. (–12). 1882.

On *Ranunculus Eschscholtzii* Schlecht. (*R. nivalis Eschscholtzii* Wats.): *273*, Aug. 13, 1903, near Lake Mary, Big Cottonwood Canyon, 9,505 feet. On *Ranunculus stenolobus* Rydb.: *918*, Aug. 11, 1906, Big Cottonwood Canyon near Lake Catherine,

9,930 feet; *919*, Aug. 11, 1906, Little Cottonwood Canyon, 9,000 feet. Rare.

EXSICCATI: Fungi Utah. *109*.

93. PUCCINIA RUBIGO-VERA (DC.) Wint. II, III,

Fl. Fr. **6**: 83. Rabenh. Krypt. Fl. **1**[1]: 217. 1884.

On *Bromus Porteri* (Coult.) Nash: *1137*, II, Aug. 21, 1908, Parley's Canyon. On *Bromus sterilis* L.: *1145*, II, Aug. 21, 1908, Parley's Canyon. On *Elymus canadensis* L.: *1144*, II, Aug. 21, 1908, near Salt Lake City. On *Elymus glaucus* Buckl.: *1010*, II, III, June 29, 1907, Parley's Canyon. On *Hordeum jubatum* L.: *2038*, II, July 21, 1909, Red Butte Canyon. On *Hordeum nodosum* L.: *1195*, II, Nov. 14, 1908, Salt Lake City. On *Hordeum pusillum* Nutt.: *166*, II, Oct. 9, 1902, Liberty Park, Salt Lake City.

EXSICCATI: Fungi Utah. *138, 139*.

94. PUCCINIA RHODIOLAE Berk. & Br.

Ann. Mag. Nat. Hist. II. **5**: 462. 1850.

On *Sedum debile* Watson: *1110*, Aug. 6, 1908, Bingham Canyon, Oquirrh Mts., Salt Lake Co. Very rare, having been taken but once in Utah.

95. PUCCINIA SCANDICA Johans, III,

Bot. Notiser **1886**: 175.

On *Epilobium alpinum* L.: *508*, Aug. 27, 1904, Big Cottonwood Canyon, 9,500 feet. On *Epilobium clavatum* Trelease: *853*, Aug. 23, 1905, Big Cottonwood Canyon, 10,000 feet. On *Epilobium Hornemanni* Reichenb.: *840a*, Aug. 15, 1905, Big Cottonwood Canyon. Host *1616*, determined by Dr. Rydberg.

EXSICCATI: Fungi Utah. *84, 140*.

96. PUCCINIA SHERARDIANA Körn. (*P. Malvastri* Peck),

Hedwigia **16**: 19. 1877.

On leaves of *Sphaeralcea grossulariaefolia*: *1064*, Sept. 28, 1907, American Fork, Utah. Co. On leaves of *Sphaeralcea*

Munroana (Dougl.) Spach.: *1116*, Aug. 11, 1908, Gogorza, Summit Co., 6,329 feet.

EXSICCATI: Fungi Utah. *167*.

97. PUCCINIA SOLIDAGINIS Peck, III,

Bull. Torrey Club **11**: 49. 1884.

On leaves and flowering stems of *Petradoria pumila* (Gray) Greene, (*Solidago pumile* Gray): *227*, June 27, 1903, Wasatch Mts. near Salt Lake City. On leaves and stems of *Solidago pulcherrima* A. Nelson: *233*, July 2, 1903, City Creek Canyon. These specimens differ from the type in their thin walls and the rounded apex. (The host was given as *S. mollis* Bartl. in Fungi Utah. *18*.) On *Solidago trinervata* Greene: *441*, July 12, 1904, Red Butte Canyon, 5,200 feet. Dr. Arthur successfully sowed germinating spores from this host (collected April 22, 1905, from the same locality as *441*) on *S. canadensis*. (See "Cultures of Uredineae in 1905" in Jour. Myc. **12**: 22. 1906.)

EXSICCATI: Fungi Utah. *18, 43, 141;* Fungi Columb. *1975*.

98. PUCCINIA SP. II, III,

On *Agropyron caninum* (L.) Beauv.: *937*, II, III, Aug. 25, 1906, Big Cottonwood Canyon, 8,650 feet. On *Agropyron repens* Beauv.: *316*, Sept. 3, 1903, Red Butte Canyon. On *Agropyron spicatum* (Pursh) Scribn. & Smith: *1160*, Aug. 28, 1908, Red Butte Canyon.

There are two *Aecidia* which have been collected within a few feet of where this *Puccinia* was afterward found. On June 22, 1904, a collection of *Aecidium Hydrophylli* was made. The leaves of nearby *Agropyron* plants were yellow with the aecidial spores. At a later date abundant material was taken from these plants. I have scarcely ever collected an *Aecidium* on *Thalictrum* without finding *Agropyron* plants in the immediate vicinity, bearing weathered or fresh *Puccinia*.

99. PUCCINIA SP. X, III,

On *Carex* sp.: *2016*, July 6, near Pharaoh's Glen, Parley's Canyon.

100. PUCCINIA SP.

On *Sporobolus filiformis* (Thurb.) Rydb.: *984a,* Sept. 29, 1906, Thistle Junction, Utah Co., 5,033 feet.

101. PUCCINIA STIPAE Arth. II, III,

Bull. Iowa Agr. Coll. 1884. 160.

On *Stipa minor* (Vasey) Scrib.: *2084,* Aug. 26, 1909, near Gogorza, Summit Co. These spores are more nearly round than those of the type. Its aecial stage has been found to be on *Aster.*

102. PUCCINIA SP.

On unknown grass (possibly *Holcus lanatus*): *2023,* July 17, 1909, Emigration Canyon, Salt Lake Co.

103. PUCCINIA SUBCIRCINATA Ellis & Ev. I, III,

Jour. Myc. 3: 56. 1887.

On *Senecio dispar* A. Nelson, (*S. lugens* Richards in part): *184,* III, May 2, 1903, near Salt Lake City, 4,500 feet; *214,* I, June 12, 1903, same locality as *184.* On leaves and stems of *Senecio crassulus* A. Gray: *917,* I, III, Aug. 11, 1906, near Lake Minnie, Little Cottonwood Canyon, 9,000 feet. On leaves and stems of *Senecio triangularis* Hook.: *299,* I, III, Aug. 17, Big Cottonwood Canyon, 8,700 feet.

EXSICCATI: Fungi Utah. *29, 106.*

104. PUCCINIA SUBDECORA Syd. & Holw. II, III,

Ann. Myc. 1: 17. 1903.

On *Brickellia grandiflora* Nutt.? (*Coleosanthus grandiflorus* Kuntze?): *672,* June 22, 1905, Mill Creek Canyon, about 7,000 feet. Sori on stem beneath the surface of the earth. Very rare.

105. PUCCINIA SUBNITENS Dietel,

Erythea 3: 81. 1895.

On *Distichlis stricta* (Thurb.) Rydb.: *1135,* Aug. 18, 1908, Poplar Grove, near Salt Lake City.

This rust is remarkable in the number of species of host-plants capable of infection by its aecidial spores. Rev. J. M. Bates has

found its aecia on *Cleome serrulata, Chenopodium album, Radicula sinuata, Sophia incisa,* and *Salsola Tragus.* Dr. Arthur's culture work has confirmed these hosts, and added *Lepidium apetalum, L. virginicum* and *Erysimum asperum* to the list, eight species representing three families of plants!

EXSICCATI: Fungi Utah. *169.*

106. PUCCINIA SUKSDORFII Ellis & Ev. III,
Jour. Myc. **7**: 130. 1892.

On *Agoseris elata* (Nutt.) Greene: *1001,* June 22, 1907, summit of ridge of Wasatch Mts. near Salt Lake City.

EXSICCATI: Fungi Utah. *170.*

107. PUCCINIA SUBSTERILIS Ellis & Ev. II, III, X,
Bull. Torrey Club **22**: 58. 1895.

On *Stipa minor* (Vasey) Scribn.: *2095,* Aug. 26, 1909, near Gogorza, Summit Co. (Parley's Canyon).

108. PUCCINIA TARAXACI Plowright, II, III,
British Ured. & Ustilag. 186. 1889.

On *Taraxacum officinale* Weber, (*T. taraxacum* Karst): *213,* II, June 12, 1903, Salt Lake City, 4,450 feet; *331,* III, Oct. 4, 1903, same locality as *213.*

109. PUCCINIA THALICTRI Chev. III,
Fl. Paris **1**: 417. 1826.

On *Thalictrum sparsiflorum* Turcz.: *818,* Aug. 10, 1905, near Lake Solitude, Big Cottonwood Canyon. Host *1972,* determined by Dr. Rydberg. Mr. Holway considers this species to be the same as *P. Pulsatillae.* Specimens were issued under the latter name in Fungi Utah. *113.*

110. PUCCINIA THLASPEOS Schubert, III,
Fl. Dresden **2**: 254. 1823.

On *Thlaspi glaucum* A. Nelson: *681,* July 7, 1905, near Silver Lake, Big Cottonwood Canyon, 8,750 feet. On *Thlaspi coloradensis* Rydb.: *734,* July 3, 1905, near Lake Phoebe, Big Cottonwood Canyon, 9,475 feet.

EXSICCATI: Fungi Utah. *142.*

111. PUCCINIA TOSTA Arth. II, III,
Bull. Torrey Club **29**: 228. 1902.

On *Sporobolus asperifolius* (Nees & Meyen) Thurb.: *486*, II, Aug. 18, 1904, Liberty Park, Salt Lake City; *597*, III, Sept. 17, 1904, same locality as *486*.

EXSICCATI: Fungi Utah. *59*, *60*.

112. PUCCINIA TRELEASIANA Pazschke, III,
Rabenh. Fungi Eur. *3831*.

On *Caltha leptosepala* DC.: *283*, Aug. 14, 1903, near Lake Catherine, Big Cottonwood Canyon, 9,932 feet.

EXSICCATI: Fungi Utah. *23*; Fungi Columb. *1868*.

113. PUCCINIA TRISETI Erik.
Ann. Sci. Nat. VIII. **9**: 277. 1899.

On *Trisetum spicatum* Richter: *847*, Aug. 21, 1905, Big Cottonwood Canyon. Probably the telial stage of *Aecidium monoicum* Peck (q. v.).

114. PUCCINIA TROXIMONTIS Peck, II, III,
Bot. Gaz. **6**: 227. 1881.

On *Ptilocalais major* (A. Gray) Greene: *182*, II, III, May 2, 1903, Salt Lake City. On *Agoseris leontodon* Rydb.: *191*, II, May 9, 1903, Salt Lake Co. On *Agoseris heterophylla* (Nutt.) Greene: *659*, June 9, 1905, Wasatch Mts., Salt Lake Co. On *Ptilocalais graciloba* Greene: *689*, June 29, 1905, Big Cottonwood Canyon, 8,300 feet. On *Agoseris Greenei* (A. Gray) Rydb., (*Troximon gracilens Greenei* A. Gray): *814*, Aug. 9, 1905, Big Cottonwood Canyon, 9,300 feet. On *Agoseris gracilens* (A. Gray) Greene, (*Troximon gracilens* A. Gray): *931*, Aug. 16, 1906, near Lake Solitude, Big Cottonwood Canyon, 9,000 feet.

Type collected in Utah on *Troximon cuspidatum* by M. E. Jones.

EXSICCATI: Fungi Utah. *70*, *115*, *171*.

115. PUCCINIA TUBERCULANS Ellis & Ev. III,
Proc. Acad. Phila. **1893**: 153. 1893.

On *Chrysothamnus viscidiflorus* (Hook.) Nutt., (*Bigelovia Douglasii* A. Gray): *226*, June 27, 1903, Wasatch Mts. near Salt

Lake City. On *Chrysothamnus pulcherrimus* A. Nelson: *887*, June 23, 1906, Parley's Canyon, altitude about 5,100 feet.

The type of this species was collected on leaves of *Aplopappus* by Prof. M. E. Jones in Nevada.

EXSICCATI: Fungi Utah. *143*.

116. PUCCINIA UNIVERSALIS Arth.

Jour. Myc. **14**: 21. 1908.

On *Carex stenophylla* Wahl.: *2069*, Aug. 3, 1909, Fish Creek Canyon, western Sevier Co. Determined by Dr. Arthur.

117. PUCCINIA UTAHENSIS Garrett, III,

In Holway's North American Uredineae **1**: 46. 1906.

On *Thlaspi glaucum* A. Nelson: *779*, July 29, 1905, Big Cottonwood Canyon. Type collection. Very rare. It has been found in the type locality only.

EXSICCATI: Fungi Utah. *144*.

118. PUCCINIA VERATRI Duby, I, II, III,

In Bot. Gall. **2**: 890. 1830.

On *Epilobium alpinum* L.: *274*, I, Aug. 13, 1903, head of Big Cottonwood Canyon, 9,510 feet. On *Epilobium clavatum* Trelease: *921*, I, Aug. 11, 1906, Little Cottonwood Canyon above Alta. On *Epilobium Drummondii latiusculum* Rydb.? *852*, I, Aug. 23, 1905, Big Cottonwood Canyon. On *Epilobium rubricaule* Rydb.: *686*, I, July 8, 1905, Big Cottonwood Canyon. The *Epilobium* plants were growing around plants of *Veratrum*. On *Epilobium straminium* Rydb.: *913*, I, Aug. 3, 1906, Big Cottonwood Canyon below Silver Lake. Host *1893*, determined by Dr. Rydberg. On stems, leaves and seedling plants of *Veratrum speciosum* Rydb.: *291*, on stems and leaves, Aug. 16, 1903, Big Cottonwood Canyon, 8,700 feet. Rather common.

In the Ann. Myc., Dr. Tranzschel has shown that the aecia on *Epilobium* are connected with *P. Veratri*.

EXSICCATI: Fungi Utah. *82*, *135*, *159*. (The last two were issued under the name of *P. Epilobii-tetragoni*.)

119. PUCCINIA VIOLAE (Schum.) DC. I, II, III,
Fl. Fr. 6: 62. 1915.

On *Viola longipes* Nutt.: *478*, Aug. 5, 1904, City Creek Canyon, 5,900 feet.

EXSICCATI: Fungi Utah. *48*.

120. PUCCINIA WYETHIAE (Peck) Ellis & Ev.
N. Am. Fungi *2987*.

On leaves and stems of *Wyethia amplexicaulis* Nutt.: *205*, May 29, 1903, Wasatch mountains near Salt Lake City. In these specimens, the spores are somewhat larger than those of the type.

EXSICCATI: Fungi Utah. *11;* Fungi Columb. *1870*.

121. PUCCINIA XANTHIIFOLIA Ellis & Ev. III,
Jour. Myc. 6: 120. 1890.

On leaves of *Iva xanthiifolia* Nutt.: *2114*, Oct. 9, 1909, near Wasatch Resort, Little Cottonwood Canyon.

122. PUCCINIA ZAUSCHNERIAE Syd. I, III,
Monog. Ured. 1: 435. 1903.

On *Zauschneria Garrettii* A. Nelson: *760*, I, June 22, 1905, Mill Creek Canyon; *1049*, III, Aug. 28, 1907, Parley's Canyon. In this collection, one-celled and three-celled spores are not uncommon.

The plants attacked by the aecia become slender and the leaves become hypertrophied, thereby indicating a perennial mycelium. Mr. Holway considers this species to be a form of *P. Oenotherae* Vize.

EXSICCATI: Fungi Utah. *145*, *173*.

123. PUCCINIASTRUM PUSTULATUM (Pers.) Dietel, (*P. Epilobii* Otth.). II,
E. & P. Nat. Pfl. 1^1: 47. 1897.

On *Epilobium adenocaulon* Haussk.: *604*, Oct. 1, 1904, Red Butte Canyon, 6,000 feet; *877*, May 19, 1906, on seedlings, Upper Falls, Provo Canyon, Utah Co.; *2057*, July 31, 1909,

Fish Creek Canyon, Sevier Co. On *Epilobium anagallidifolium* Lam.: *807*, Aug. 4, 1905, Silver Lake, Big Cottonwood Canyon, 8,750 feet. On *Epilobium Drummondii* Haussk.: *948*, Aug. 25, 1906, near Silver Lake, Big Cottonwood Canyon. Host *2016*, determined by Dr. Rydberg. On *Epilobium brevistylum* Barbey: *949*, Aug. 25, 1906, near Silver Lake, Big Cottonwood Canyon. Host *2017*, determined by Dr. Rydberg.

EXSICCATI: Fungi Utah. *95*, *111*.

124. PUCCINIASTRUM MYRTILLI (Schum.) Arth. (*Melampsora Vacciniorum* Schröt.)

Résult. Sci. Congr. Bot. Vienne 337. 1906.

On *Vaccinium caespitosum* Michx.: *526a*, Aug. 1904, Big Cottonwood Canyon. Determined by Dr. P. Sydow.

125. PUCCINIASTRUM PYROLAE (Pers.) Dietel, (*Thecopsora Pyrolae* Karst),

in E. & P. Nat. Pfl. 1^1: 47. 1897.

On *Pyrola asarifolia incarnata* (Fisch.) Fernald, (*P. uliginosa* Torr.; *P. rotundifolia uliginosa* Gray): *608*, Oct. 1, 1904, Red Butte Canyon. On *Pyrola secunda* L.: *713*, July 5, 1905, Big Cottonwood Canyon.

126. TRIPHRAGMIUM ECHINATUM Lév.

Ann. Sci. Nat. III, 9: 247. 1848.

On *Ligusticum filicinum* Wats.: *509*, Aug. 24, 1904, Big Cottonwood Canyon, 9,410 feet. Found but once, and then but a single specimen.

127. UROMYCES ACONITI-LYCOCTONI (DC.) Wint. I, III,

Rabenh. Krypt. Fl. 1^1: 153. 1884.

On *Aconitum columbianum* Nutt.: *314*, Sept. 3, 1903, Red Butte Canyon. The aecia were found in many cases hidden just beneath the surface of the ground, so that probably they often escape detection.

EXSICCATI: Fungi Columb. *1892*.

128. UROMYCES ALBUS Dietel. & Holw. I, III,
Hedwigia **36**: 297. 1897.

On *Vicia trifida* Schw.: *201*, I, May 23, 1903, near Salt Lake City, 4,475 feet; *201a*, III, same date and locality as *201*. In this material, one two-celled teliospore was found. On *Vicia americana truncata* (Nutt.) Brewer, (*V. oregana* Nutt.): *434*, III, July 7, 1904, City Creek Canyon, at about 6,000 feet.

Aecidium porosum Peck is the aecial stage of this rust.

EXSICCATI: Fungi Utah. *122*; Fungi Columb. *1894*.

129. UROMYCES ASTRAGALI (Opiz.) Schröt. II, III,
Pilze Sch. **1**: 308. 1887.

On *Astragalus decumbens* Gray? *1111*, Aug. 6, 1908, Bingham Canyon, Oquirrh mountains, Salt Lake Co. On *Astragalus utahensis* T. & G.: *996*, June 22, 1907, Wasatch mountains near Salt Lake City. The rust attacks the stem as well as the leaves of the host. On *Astragalus Purshii* Dougl.: *2046*, July 28, 1909, Fish Creek Canyon, western Sevier Co. On *Astragalus Wardii* A. Gray: *2045*, July 28, 1909, Fish Creek Canyon, western Sevier Co. On *Astragalus diphysus* A. Gray: *2088*, Parley's Park, Parley's Canyon, Aug. 26, 1909.

Sydow holds that this rust is not *U. Astragali*, but possibly *Uredo Oxytropidis* Peck.

EXSICCATI: Fungi Utah. *146*.

130. UROMYCES CARYOPHYLLINUS (Schrank) Wint.
Rabenh. Krypt. Fl. **1**[1]: 149. 1884.

On *Dianthus caryophyllus* L., cult. *2127*. March 26, 1910, Salt Lake City.

131. UROMYCES ERIOGONI Ellis & Hark. I, II, III,
Bull. Calif. Acad. **1**: 29. 1884.

On *Eriogonum campanulatum* Nutt.: *900*, I, II, III, July 17, 1906, Parley's Canyon, altitude about 5,200 feet. On *Eriogonum heracleoides* Nutt.: *206*, I, May 30, 1903, City Creek Canyon; *239*, II, July 2, 1903, City Creek Canyon; *321*, III, Sept. 3, 1903,

Red Butte Canyon. On *Eriogonum racemosum* Nutt.: *224*, I, June 22, 1903, City Creek Canyon; *972*, II, Sept. 13, 1906, Parley's Canyon. On *Eriogonum umbellatum majus* Benth.: *2016*, II, July 11, 1909, Emigration Canyon.

EXSICCATI: Fungi Utah. *12, 13, 120, 147, 174.*

132. UROMYCES EUPHORBIAE Cooke & Peck, I, III,

Rep. N. Y. State Mus. **25**: 90. 1872.

On *Euphorbia serpyllifolia* Pers.: *729*, I, III, July 6, 1905, Little Snake Creek Canyon, Wasatch mountains, Wasatch Co. On *Euphorbia dentata* Michx.: *1177*, I, III, Sept. 4, 1908, Salt Lake City.

EXSICCATI: Fungi Utah. *148, 175.*

133. UROMYCES GLYCYRRHIZAE (Rabenh.) Magn. II, III,

Bericht der Deutsch. Bot. Gesell. **8**: 383. 1890.

On all chlorophyll-containing parts of *Glycyrrhiza lepidota* Nutt.: *200*, II, May 19, 1903, Salt Lake City, 4,450 feet; *724*, II, July 6, 1905, "Hot Pots," Wasatch Co., 6,912 feet; *868*, III, Aug. 31, 1905, Salt Lake City; *2056*, II, July 31, 1909, Fish Creek Canyon, western Sevier Co. Quite common.

EXSICCATI: Fungi Utah. *98, 99.*

134. UROMYCES HEDYSARI-OBSCURI (DC.) Wint. I, III,

Rabenh. Krypt. Fl. **1**[1]: 152. 1884.

On *Hedysarum utahense* Rydb.: *2099*, Oct. 2, 1909, Emigration Canyon; *2122*, Oct. 16, 1909, Ogden Canyon, near Idlewild.

135. UROMYCES HETERODERMUS Syd. III,

Ann. Myc. **4**: 29. 1906.

On *Erythronium grandiflorum parviflorum* S. Wats. (*E. parviflorum* Goodding): *698*, July 7, 1905, near Brighton, Big Cottonwood Canyon, 8,800 feet. Type collection.

EXSICCATI: Fungi Utah. *118.*

136. UROMYCES JUNCI (Desm.) Lév. II, III,

Desm. Pl. Crypt. ed. 2, No. *170*.

On *Juncus saximontanus* A. Nelson, (*J. xiphioides montanus* Engelm.): *311*, Sept. 3, 1903, Red Butte Canyon. On *Juncus longistylis* S. Wats.: *1115*, II, III, Aug. 11, 1908, Gogorza, Summit Co., 6,329 feet.

EXSICCATI: Fungi Utah. *149*. (Issued as *U. lupinicola* Bubak.)

137. UROMYCES FABAE (Pers.) De Bary, I, II, III,

Ann. Sci. Nat. IV. **20**: 72. 1863.

On *Lathyrus coreaceus* White: *464*, July 20, 1904, Wasatch mountains near Salt Lake City, at about 6,000 feet altitude. On *Lathyrus utahensis* Jones: *466*, July 20, 1904, Wasatch mountains near Salt Lake City, at about 6,000 feet altitude; *977*, III, Sept. 13, 1906, Parley's Canyon, at about 7,000 feet altitude.

EXSICCATI: Fungi Utah. *123*, *124*, *125*.

138. UROMYCES OCCIDENTALIS Dietel,

Hedwigia Beibl. **42**: 98. 1903.

On *Lupinus parviflorus* Nutt.: *2063*, Aug. 2, 1909, Fish Creek Canyon, western Sevier Co. On *Lupinus pulcherrimus* Rydb.: *968*, Sept. 6, 1906, City Creek Canyon, at about 5,600 feet altitude. Rare.

EXSICCATI: Fungi Utah. *119*.

139. UROMYCES POLYGONI (Pers.) Fuckel, II, III,

Disp. Meth. Fung. p. 30, 1801. (*Puccinia Polygoni* Pers.)

On *Polygonum aviculare* L.: *1184*, Sept. 26, 1908, Salt Lake City.

140. UROMYCES PLUMBARIUS Peck, I, II, III,

Bot. Gaz. **4**: 127. 1879.

On *Oenothera caespitosa* Nutt., (*Pachylophus caespitosus* Raimann): *899*, I, II, July 17, 1906, Parley's Canyon; *973*, II, III, Sept. 13, 1906, Parley's Canyon, altitude about 5,200 feet. On *Oenothera marginata* Nutt., (*Pachylophus marginatus* Rydb.):

1197, I, II, III, Nov. 21, 1908, near Salt Lake City: *2048*, I, II, III, July 28, 1909, Fish Creek Canyon, western Sevier Co.

EXSICCATI: Fungi Utah. *117, 150.*

141. UROMYCES TRANZSCHELII Syd. II, III,

Ann. Myc. **8**: 20. 1910.

On *Euphorbia robusta* (Engelm.) Small, (*E. montana robusta* Engelm.): *706*, II, July 3, 1905, Little Cottonwood Canyon; *722*, II, July 6, 1905, Wasatch Mts., Wasatch Co., at about 9,500 feet altitude; *2055*, July 31, 1909, Fish Creek Canyon, western Sevier Co.

EXSICCATI: Fungi Utah. *97*. (Issued as *U. andina* Magn.)

142. UROMYCES TRIFOLII (Albert & Schw.) Wint. I, III,

Rabenh. Krypt. Fl. 1^1: 159. 1884.

On *Trifolium repens* L.: *479*, Aug. 5, 1904, City Creek Canyon, at about 6,000 feet altitude. Not common.

EXSICCATI: Fungi Utah. *121*.

143. UROMYCES ZYGADENI Peck, I, III,

Bot. Gaz. **6**: 239. 1881.

On *Zygadenus paniculatus* Watson: *179*, I, April 25, near Salt Lake City, 4,475 feet; *197*, III, May 15, 1903, near Salt Lake City, 4,500 feet. Not common.

144. UROPYXIS SANGUINEA (Peck) Arth. II, III, (*Puccinia mirabilissima* Pk.),

N. Am. Flora **7**: 155. 1907.

On *Berberis repens* Lindl.: *188*, May 9, 1903, Wasatch Mts. near Salt Lake City. Common; *2151*, July 29, 1909, Fish Creek Canyon, western Sevier Co.

EXSICCATI: Fungi Utah. *10*.

HIGH SCHOOL,
SALT LAKE CITY, UTAH.

A NEW BOLETUS FROM JAMAICA

William A. Murrill

During the winter of 1907–8, two species of Boletaceae, the only representatives of the family known from the island, were collected in Jamaica. One of these, *Rostkovites granulatus,* was rather common at Cinchona, at an elevation of 5,000 feet, but, being a temperate species, did not occur at lower elevations. The other, described below, was found in the famous Cockpit Country, a limestone region of 2,000 feet elevation, which has yielded many botanical novelties in recent years.

Gyroporus jamaicensis sp. nov.

Pileus fleshy, small, convex, circular in outline, 1.8 cm. in diameter, 5 mm. thick; surface umbrinous, viscid, finely areolate in places, cuticle tough: context white, unchanging, 1 mm. thick behind, taste slightly mucilaginous; hymenium readily separating from the context, nearly plane, slightly distant from the stipe, tubes white throughout, unchanging, 3.5 mm. long, mouths circular, regular, 4–5 to a mm., edges thin, conspicuously denticulate: spores elongate, smooth, hyaline, $10–12 \times 4–5\,\mu$: stipe central, white, subglabrous, smooth, cylindric, curved, 3 cm. long, 3.5 mm. thick, slightly tapering at the base.

Type collected in Troy, Jamaica, at an elevation of 670 meters, in grass in a young growth of coppice on the north slope of a small hill, January 12, 1909, *W. A. Murrill & W. Harris 1093.*

NEWS AND NOTES

Dr. W. A. Murrill, assistant director of the Garden and editor of MYCOLOGIA, recently spent several weeks in Europe examining types of fungi in various European herbaria.

Mr. F. D. Kern, assistant to Dr. J. C. Arthur of the agricultural experiment station, Lafayette, Indiana, has taken up his residence in New York City as fellow in botany in Columbia University. As part of his major work, Mr. Kern will continue his researches on the genus *Gymnosporangium*.

Mr. Guy West Wilson, for several years past professor of biology in Upper Iowa University, Fayette, Iowa, and formerly research scholar in the New York Botanical Garden, has recently accepted the position of assistant in vegetable pathology in the North Carolina Agricultural Experiment Station.

Mr. Wilmer G. Stover, formerly assistant in the department of botany at Miami University, has been appointed instructor in botany in the Ohio State University, to supply the place made vacant by assistant professor Griggs, who is on leave of absence for one year. In addition to other duties, Mr. Stover will have charge of a course in mycology and fungous diseases of plants for the agricultural college students.

Mr. B. O. Dodge, of Columbia University, accompanied by Mrs. Dodge, spent a week in September at White Post, Virginia, in the Shenandoah Valley, collecting fungi. Special attention was given to parasitic fungi occurring on the estate of Mr. Graham F. Brandy.

Mr. Fred J. Seaver, director of the laboratories, spent a part of August and September collecting fungi in the Rocky Moun-

tains about Denver, Colorado. A large collection of fungi was made at elevations ranging from 6,000 to 14,000 feet. During a part of the time he was accompanied by Professor E. Bethel, of the East Denver High School.

Dr. Melchior Treub, for many years director of the famous botanical garden at Buitenzorg, Java, and director of the Department of Agriculture for the Dutch East Indies, died at Saint-Raphaël, Var, France, on October 3. He was born near Leyden in 1851. Dr. Treub was editor of the important Annales du Jardin Botanique de Buitenzorg, beginning with its second volume in 1885 and retaining this editorship even since his retirement about a year ago. He was the author of many noteworthy botanical papers, covering a wide range of topics.

A new book entitled Diseases of Economic Plants, by F. L. Stevens and J. G. Hall, of the North Carolina Agricultural Experiment Station, has recently appeared. This work is designed to meet the needs of those students who wish to recognize, wherever this can be done with any degree of certainty, and treat diseases of plants without the laborious process of a detailed microscopic study. Those characters are used in diagnosing diseases which are evident to the naked eye or through the aid of the hand lens, and technicalities are avoided so far as possible, thus making the text a usable one to the agricultural students of the lower grades. The work is confined mainly to the bacterial and fungous diseases.

The introductory chapters contain a brief historical sketch of the development of the science of phytopathology; also statistics regarding the damage caused by fungi, symptoms of disease, methods of preventing diseases, formulae of the various fungicides with directions as to the best methods of applying them, and a discussion of the cost and profit resulting from their use.

The body of the work is devoted to a description of the symptoms of the diseases of plants which are of economic importance with directions as to the best methods of controlling them. These diseases are classified according to the natural relationship of the

hosts on which they occur and all of the diseases of a given host are treated under that host regardless of the relationships of the fungi which cause the diseases. The terms used in designating the various diseases are those most commonly used, or, where these are lacking or ambiguous, a name is made by adding the termination "ose" to the generic name of the fungus which causes the disease. The work is thoroughly illustrated, the illustrations being of such a nature as to be of material aid in the diagnosis of the various diseases.

The appendix contains a brief discussion of the differences in the physiology of the chlorophyl-bearing and chlorophylless plants with a few of the most striking morphological characters of the bacteria and fungi. This part of the work is very brief.

One of the points on which the work is to be commended is the fact that the manuscript of the various parts has been submitted to the best specialists in the groups treated for corrections and criticism, thus eliminating many of the errors which might otherwise appear in a work of this kind and ensuring accuracy as to details. The book will doubtless meet the need of a large number of students, especially in our agricultural colleges.

F. J. SEAVER.

INDEX TO VOLUME II

New names, and the final members of new combinations, are in **bold face type**